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TABLE OF CONTENTS

04-17 SCIENTIFIC FINDINGS

01 Oil Extraction from Soybean Seeds through Hydraulic Pressing and Valorization of its by-Product

02 A Study on Compressive Strength of Concrete with Class F Fly Ash as a Partial Fine Aggregate Replacement Material

03 Ozone Treatment on Silk Fabric

18-25 TECHNOLOGY TRENDS

04 Introduction to Hydroponic Farming

05 Digital Transformation for Public Works and Transportations in Cambodia

26-31 STI POLICY

06 Cambodia Enterprise Innovation Index: A Conceptual Framework

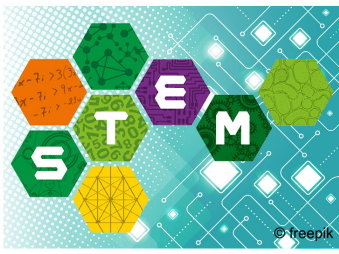
32-47 STEM EDUCATION AND CAREERS

07 Operation Chou Li Episode V, Find Earth's Axis Tilt from Ancient Khmer Prasat Phupek, Sakon Nakhon Thailand

08 Enhancing Comprehension in Physics for Lower Secondary School Students Using 3D Printing Technology

09 A Journey from Engineer to be a CEO in a Tourism Tech-Startup

10 Driver for Career Development: STI Education



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FOREWORD

The National Institute of Science, Technolgy and Innovation (NISTI) mandate is to engage the public in the promotion and advancement of STI for economic growth and national prosperity. Therefore, public communication of science is essential. I warmly welcome this new issue of STI Focus that addresses new scientific and technological trends, emerging STI Policy, and STEM Education fresh perspectives. All articles have been written by Cambodian scholars and practitioners who have earned their degrees from either Cambodia or from reputable universities abroad.

I have read this issue with great interest and found its contents to be extremely informative and wish to wholeheartedly congratulate all authors. These articles will certainly contribute to a better public understanding of science as a way to improve our everyday life. They will certainly inform all policy makers about the value of STI, as a path for strengthening industrialization to allow Cambodia's economy to be competitive in the region and beyond. The key to this approach is to build a robust national STI ecosystem while promoting the commercialization of technology innovation and R&D in our nascent industry. To support the process of industrialization, high quality STEM manpower is critical. Thus increasing the number of highly qualified technicians, engineers and scientists is essential, if Cambodia wishes to reach her full socio-economic development goals. Engaging women to embrace STEM careers must also be part of this endeavor. As always, I wish you good reading.

Phnom Penh, 30 January 2023

Senior Minister

Minister of Industry, Science, Technology & Innovation

***Kitti Setha Pandita* CHAM Prasidh**

EDITORIAL NOTE

The core mission of STI Focus is to contribute to the Promotion and Advancement of science, technology, and innovation knowledge in view to consolidate the national STI ecosystem of Cambodia. It informs academia, the public and private sectors about the latest developments of STI knowledge and best practices. The STI Focus Volume I, Issue 1, was published online in June 2022 on the Website of Ministry of Industry, Science, Technology & Innovation (MISTI).

In this issue, manuscripts from different streams of research outputs, technology, policy, and technological know-how reflect our STI Focus's objectives including: 1) To establish an STI Focus as a medium of publication communication of science; 2) To disseminate the scientific findings, technology trends, and STI policy; and 3) To promote STEM education and careers in Cambodia.

All papers published had gone through a thorough peer-reviewed process to assess their quality before they are published. We would like to express our sincere gratitude and appreciation to all contributors for their hard work and dedication to produce this STI Focus Volume I, Issue 2. We would like to thank the Technical Team at the National Institute of Science, Technology and Innovation (NISTI) for their editorial support. Above all, we wish all readers an enjoyable experience.

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SCIENTIFIC FINDINGS

Oil Extraction from Soybean Seeds Through Hydraulic Pressing and Valorization of Its by-Product

01

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Highlight

• The study aims to extract soybean oil using hydraulic pressing and protein from de-oil cakes. The soybean was pressed at 60°C of temperature under 50 MPa pressure by hydraulic pressing for 60 min. The crude oil obtained was analyzed for physicochemical quality, while the de-oil cakes were subjected to determine the proximate composition.

• After that, the de-oil cakes were used for protein extraction under five different conditions, including aqueous extraction and ultrasonication. The results found that the oil yield was 12.49 ± 0.53%. The physicochemical properties of crude oil extracted, such as peroxide value, iodine value, and acid value, were acceptable. In addition, protein extracted from oil cakes using 2 min sonication time with 30 min of aqueous extraction obtained a maximum yield of 43.74%.

1. Introduction

The soybean (Glycine max L.) is among the most essential leguminous plants feeding many people in the world (Miransari, 2016). In the West, the two main products of the soybean are seed oil and protein-containing meal. There are many ways of producing oil, while the hydraulic press is a mechanical extraction that is common in small-scale processors because it is less capital-intensive in terms of initial and maintenance costs. However, oil production alone cannot sustain the business due to the cost of production that determine the final price of the product, which eventually be a difficult challenge to compete with other existing oil companies. This leads to the valorization of de-oil cakes. Taking soy protein isolates into account, it is one of the vital soy protein products, usually containing 85–90 % protein (dry basis) (Tang, 2019). It can be utilized in processed meats and baby foods and is also employed as a whipping agent and coffee whitener. Additionally, it can be converted to meat analogs themselves or as textured soy protein products which are used to extend or replace meat products in food systems (Bookwalter, 1978). Therefore, the objective of this research was to extract the soybean oil using hydraulic pressing and analyze the physicochemical quality of the crude oil. Substantially, the oil cakes from the extraction determined the proximate composition and extracted the protein using ultrasonication and aqueous extraction methods.

2. Methodology

Oil extraction through a hydraulic press

Soybean seeds (350 g) were heated, and the metallic cylinder was pressed using a hydraulic system at 60°C of temperature under 50 MPa pressure for 60 minutes. After the extraction, the physicochemical properties of crude oil, such as peroxide value, iodine value, and acid value ,were also analyzed.

Protein extraction

Five different extraction conditions were described and coded as U2, U2E, U30, U30E ,and E30 ,as shown in Table 1. A using ultrasonication and aqueous extraction.

Ultrasonication

Ultrasonic bath (USC600T, Malaysia) with 45 kHz of frequency and 200 W of power was used in this stage.The experiments were conducted for 2 and 30 minutes at 25°C at room temperature.

Table 1. Variation of Protein Extraction Conditions

Methods	Ultrasonic-Assisted	Aqueous Extraction
U2	Sonicated for 2 minutes	Non
U2E	Sonicated for 2 minutes	Aqueous extraction for 30 minutes
U30	Sonicated for 30 minutes	Non
U30E	Sonicated for 30 minutes	Aqueous extraction for 30 minutes
E30	Non	Aqueous extraction for 30 minutes

Table 2. Soybean De-Oil Cake Characteristics

Composition	De-Oil Cake ± SD	Federation et al., (2013)
Moisture (%)	9.16 ± 0.20	9.20 ± 0.09
Fiber (%)	6.66 ± 0.45	5.00 ± 0.14
Total oil (%)	12.6 ± 0.56	1.99 ± 0.00
Total minerals (%)	5.72 ± 0.01	8.35 ± 0.27
Protein (%)	43.75 ± 0.07	50.68 ± 0.29

Aqueous extraction

The process started with pH adjustment to 8.5-9.5 using 2N NaOH, then left it stirring on a hot plate at 60°C for 30min. Next, the solution was measured and filled in falcon tubes for centrifugation for 30 minutes at 15°C with a speed of 4,000 rpm. The collected supernatant was subjected to protein analysis using AOAC 960.52 method.

3. Results and Discussion

Oil extraction and its physicochemical properties

The result shows that the oil yield from the hydraulic pressing was 12.49 ± 0.53%. Peroxide value (1.38 ± 0.26 meq/kg oil), iodine value (126.01 ± 1.68 g I2/g oil), and acid value (0.67 ± 0.00 mg KOH/g oil) were followed the standard (FAO, 2021).

De-oil cake proximate composition

The proximate composition of the de-oil cake is shown in Table 2. Federation et al., (2013) also reported de-oil cake composition. In comparison, it is discussed that our sample has lower protein content which can be explained as the oil that emained in our cake is almost ten times higher where it could alter the proportion of other compositions too; however, the difference is compatible.

Effect of extraction conditions on protein yields

The protein yields ranged from 27.53 ± 0.64 to 43.74 ± 4.35%. Figure 1. shows that the U2 sample had a lower yield than U30. This might happen due to the effect of ultrasound that destruct the protein structure into one point where more protein diffused out with water which corresponds to Li (2002). However, after aqueous extraction was applied to both samples, the result turned out differently. This might be because the ultrasonic effect is too strong where yield was released in amino acid form. Moreover, amino acids can react with NaOH producing salt and decreasing protein content in the supernatant. E30, which results in a yield that is almost as high as the extract that underwent ultrasonic assistance, it can be assumed that sonication does have an impact on protein extraction but not significantly.

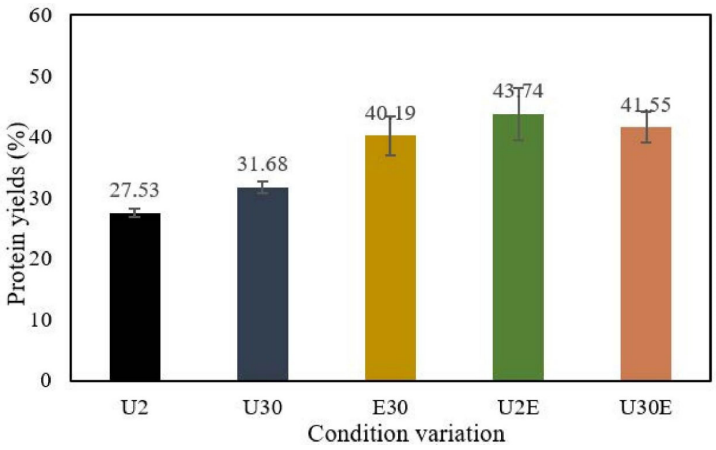

Figure 1. Protein Yields Using Different Extraction Conditions

4. Conclusion

In conclusion, there is a variety of soybean genotypes where it provides the different proportion of proximate composition. After hydraulic pressing, the yield of 12.49 ± 0.53% was detected. The best condition of protein extraction that provided the highest protein yield (43.74 ± 4.35%) was sonicating for 2 minutes followed by 30 minutes of extraction while the lowest one (27.53 ± 0.64%) is solely undergoing 2 minutes of sonication.

References

Bookwalter, G. N. (1978). Soy protein utilization in food systems. Advances in Experimental Medicine and Biology, 105, 749–766. https://doi.org/10.1007/978-1-4684-3366-1_36

FAO. (2021). STANDARD FOR NAMED VEGETABLE OILS. CXS 210-1999. 3(March), 6.

Federation, R., Observed, N., & Levels, E. (2013). Human and Animal Health Safety Assessment of Genetically Modified Plants. In Genetically Modified Food Sources. https://doi.org/10.1016/b978-0-12-405878-1.00005-7

Li, H. (2002). TRACE : Tennessee Research and Creative Exchange.

Makeri, M. U., Karim, R., Abdulkarim, M. S., Ghazali, H. M., Miskandar, M. S., & Muhammad, K. (2016). Comparative Analysis of the Physico-Chemical, Thermal, and Oxidative Properties of Winged Bean and Soybean Oils. International Journal of Food Properties, 19(12), 2769–2787. https://doi.org/10.1080/10942912.2015.1031246

Miransari, M. (2016). Soybean, Protein, and Oil Production Under Stress. In Environmental Stresses in Soybean Production: Soybean Production (Vol. 2, Issue 2014). Elsevier Inc. https://doi.org/10.1016/B978-0-12-801535-3.00007-3

Tang, C. (2019). Nanostructures of soy proteins for encapsulation of food bioactive ingredients. In Biopolymer Nanostructures for Food Encapsulation Purposes. Elsevier Inc. https://doi.org/10.1016/B978-0-12-815663-6.00010-0

A Study on Compressive Strength of Concrete with Class F Fly Ash as a Partial Fine Aggregate Replacement Material

02

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Concrete compressive machine

Highlight

- The article discusses the feasibility of using Class F fly ash as a partial fine aggregate replacement by investigating the compressive strength of the concrete.
- Large-scale mining of sand and disposal of fly ash have a detrimental effect on the environment.
- Using Class F fly ash as a partial fine aggregate replacement improved the compressive strength of the concrete with a replacement percentage of up to 60%.

1. Introduction

With the rapid urbanization worldwide, the need for concrete in the construction industry has tremendously increased. This extra demand for concrete leads to the enormous sand requirement. In 2010, the total sand extraction for only construction purposes was approximately 11 billion tons (Johnston, 2016). The extensive extraction of sand from rivers may cause floods which immensely affect the livelihood of the people. Moreover, large mining of sand changes the ecosystems of the rivers, increases suspended sediments, and causes erosion (Koehnken, 2020). Furthermore, the escalated rising of sand prices around the world is also a major challenge to the construction industry. The market price of concreting sand in Singapore had an inflation of 156% in 2019 compared to the price in 2017 (Hirschmann, 2020). Many health and environmental problems are related to the disposal of fly ash. Disposal of fly ash into the water source (ponds, rivers, seas) harms marine life. Additionally, the disposal of fly ash requires a large area of landfills. The disposal of fly ash in landfills can lead to the leaching process, which contaminates the groundwater. The leaching occurs when toxic chemicals dissolve from the fly ash when it is wetted. The toxic compounds from fly ash can reach underground water and contaminate it. The contaminated groundwater can affect directly or indirectly to its users (Singh, 2016). Fly ash can be used in many applications, such as using as a partial cement replacement material in concrete, road embankment construction material, cement clinker, stabilization material of soft soil, and mineral filler in asphalt concrete. Many of the fly ashes have been used as a cement replacement material in concrete. However, some fly ashes do not have adequate properties to be used to replace cement in concrete. The use of fly ash as a fine aggregate replacement material in concrete is another possible way to utilize fly ash. This study aims to study the possibility of using Class F fly ash as fine aggregate replacement material by investigating the compressive strength of the concrete.

2. Experimental Program

2.1 Material

The properties of mixtures containing OPC type I and Class F fly ash were studied . The chemical compositions of OPC type I and Class F fly ash were studied using X-Ray Fluorescence. The OPC type I following ASTM C150 and TIS 15 standards were used in this study. The Class F fly ash was obtained from a power plant in Rayong Province, the eastern part of Thailand, on December 2019.

Table 1: Chemical Composition of Binders

Chemical Composition (%)	OPC Type I	Class F Fly Ash
SiO_2	18.9	64.4
Al_2O_3	5.5	20.6
Fe_2O_3	3.3	3.8
CaO	65.5	2.6
MgO	1.2	1.0
Na_2O	0.1	0.4
K_2O	0.3	1.5
SO_3	2.9	0.2
LOI	-	4.0
Free lime	0.8	-

Table 2: Physical Properties of the Binders

Physical Property	OPC Type I	Class F Fly Ash
Specific gravity	3.15	2.07
Blaine fineness (cm^2/g)	3050	2210

Table 3: Physical Properties of Aggregate

Physical Property	Fine Aggregate	Coarse Aggregate
Specific gravity	2.59	2.77
Blaine fineness (cm^2/g)	0.42	0.41

2.2 Mix Proportion

There are a total of 4 mixtures in this study, FC0FS0 is the controlled mixture with only OPC Type I as the binder. FC0FS20, FC0FS40, FC0FS60 are the mixtures with fly ash as a fine aggregate replacement material at 20%, 40%, and 60%, respectively.

Table 4: Design Parameter of Concrete Mix Proportion

Mix ID	Design Parameter		
	FAs/b	w/b	γ
FC0FS0	0	0.60	1.20
FC0FS20	0.20	0.60	1.20
FC0FS40	0.40	0.60	1.20
FC0FS60	0.60	0.60	1.20

Whereas:

- FAs/b is the ratio of the fine aggregate replacement by fly ash to the total binder
- w/b is the water-to-binder ratio
- γ is the ratio of the paste volume to the void volume

2.3 Test Methods

The test procedure for this test followed the ASTM C39 standard. The temperature of the test is controlled at 24±1ºC. The specimens used in this test were 100x100x100mm cubes. The test ages were 7, 28, and 91 days. After casting, the specimens were covered by plastic sheets and aluminum foils to prevent water evaporation from the specimens. Subsequently, the specimens were demolded after 24 hours and wrapped in three layers of aluminum foil and three plastic sheet layers. The seal-cured specimens were used to conduct the tests at 7, 28, and 91 days.

3. Results and Discussions

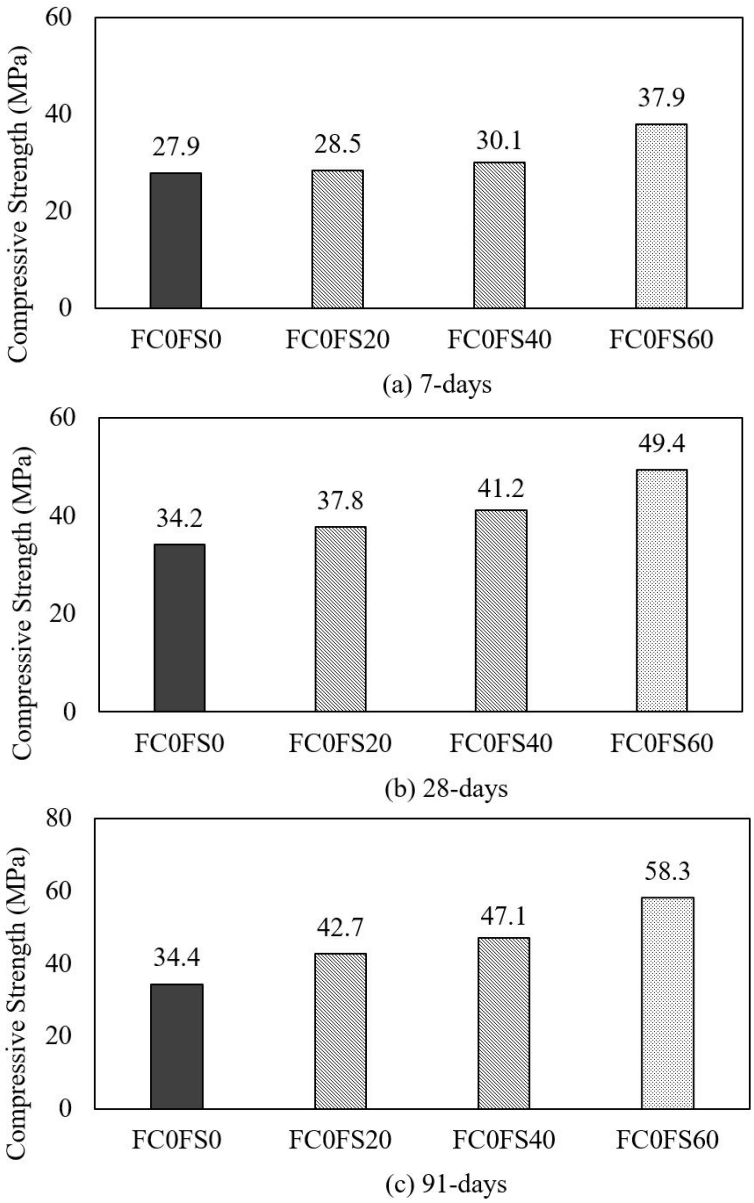

Figure 1. Compressive Strength of Concrete at Different Curing Ages

Figure 1. shows the results of the compressive strength of concrete. At all ages, the mixtures containing the substandard fly ash as sand replacement exhibited higher compressive strength than the OPC mixture. The compressive strength was higher with the increase in the sand replacement percentage. The compressive strength is improved due to the actual higher total binder content of the mixtures and lower actual w/b. The improvement of compressive strength when fly ash is used to replace sand is the result of the pozzolanic reaction and densification of the concrete (Siddique, 2003). There is a significant increase of strength at later ages for the mixtures with Class F fly ash as a partial fine aggregate replacement material. This is due to the high content of Silica (SiO2) of the Class F fly ash ,which is an essential chemical for the pozzolanic reaction, which is the dominant reaction contributing to the later age of concrete (Pok, 2021).

4. Conclusion

The use of Class F fly ash as a partial fine aggregate replacement improved the compressive strength of the concrete with a replacement percentage of up to 60%, according to the results of this study. However, for a better understanding and judgment on the use of Class F fly ash in concrete as a fine aggregate replacement, more durability properties should be studied.

References

Johnston, I. (2016). Entire islands disappear as violent gangs steal sand amid global shortage. Independent.

Koehnken, L., Rintoul, M., Goichot, M., Tickner, D., Loftus, A. C., & Acreman, M. (2020). Impacts of riverine sand mining on freshwater ecosystems: A review of the scientific evidence and guidance for future research. River Research and Applications.

Hirschmann, R. (2020). Market price of concreting sand in Singapore from 2009 to 2019. Statista.
Pok, P. (2021). Properties of cement-fly ash mixtures with substandard fly ash as a partial cement and fine aggregate replacement. ASEAN Engineering Journal, 11(3), 71-88.

Siddique, R. (2003). Effect of fine aggregate replacement with Class F fly ash on the mechanical properties of concrete. Cement and Concrete Research, 33, 539-547.

Singh, R. K., Gupta, N. C., & Guha, B. K. (2016). Fly Ash Disposal in Ash Ponds: A Threat to Ground Water Contamination. Journal of The Institution of Engineers (India): Series A, 97(3), 255-260.

Ozone Treatment on Silk Fabric 03

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Highlight

- Introduction to silk components
- Introduction to ozone treatment
- Effects of ozone treatment on silk fabric
- Comparison between ozone treatment and conventional methods (soap degumming and hydrogen peroxide bleaching)

1. Introduction

The silk fiber is composed of two main components, including 70 - 80% fibroin and 20 - 30% sericin (Figure 1), and other impurities such as wax, carbohydrates, inorganic salts, and natural coloring matter (Selvakumar & Sargunamani, 2006; Trivedy & Kumar, 2007). As the second dominant component on the filament, sericin is a kind of gum surrounding fibroin filaments in silk. It protects and keeps adhesion between fibroin filaments (Kunz, Brancalhão, Ribeiro, & Natali, 2016).

In raw silk fabric, sericin gives harshness and stiffness properties. Therefore, the degumming, which removes sericin from raw silk fabric, is one of the essential steps in the finishing process to enhance the quality of textile. In addition, bleaching the natural coloring matters of silk is compulsory to ensure proper dyeing and printing of the silk product (Aniş, Çapar, Toprak, & Yener, 2016). In responding to the need for the degumming and bleaching process, several agents can be used, such as soap and hydrogen peroxide, or other commercial oxidizers.

Among oxidizers, ozone (O_3) is described in chemical structure as triplet oxygens, and its chemical activity is useful to eliminate odor, taste, and color from water, organic compositions in wastewater treatment, and bleaching of wood pulp (Selvakumar & Sargunamani, 2006). In the textile sector, ozone treatment has been used for cotton bleaching. However, its application to silk has been considered a novel method, and there is very little research has been carried out.

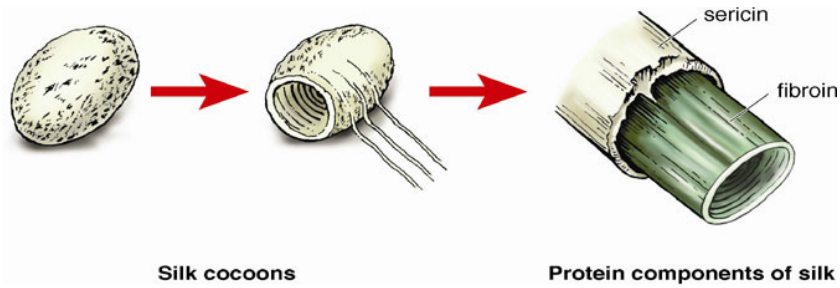

Figure 1. Components of Silk (Sobajo, Behzad, Yuan, & Bayat, 2008)

This study aimed to analyze changing properties of silk filament by utilizing the ozone treated technique and compare its effectiveness to soap degumming and hydrogen peroxide bleaching.

2. Experiment

2.1. Materials

The sample used in this study was commercial grade plain woven raw silk fabric with 132 x 98 yarns/cm, 46-denier yarn in the warp, 67-denier yarn in weft, and 56 g/m2. All chemicals were laboratory grade from Xilong company, China.

2.2. Methods

2.2.1. Ozone Treatment

The experiment was conducted with various process parameters, including treatment time (10, 20, 30 minutes), pH (4, 5), and wet pickup rate (50%). For each condition, first, 12 x 12 cm of the raw silk fabric and acid solutions at pH 4 or 5 were prepared in advance. Next, each sample was hung in an ozone applicator (Figure 2) filled with the acid solution. Then, the sample was treated by employing ozonation apparatus (60 g/m3 of ozone, 0.5 l/min of flow rate) (Figure 3) for the required time. After that, the sample with a 50% wet pickup rate was washed with water and then soaped in 2 g/l solutions of Marseille soap at 90°C for 10 min, followed by washing, drying, and conditioning (Selvakumar & Sargunamani, 2006).

2.2.2. Soap Degumming

The raw silk fabric was cut into 35 x 35 cm dimensions for degumming in Auto-Chroma IR infrared dyeing machine with submerged with 5 g/l Marseille soap, 1 g/l sodium carbonate (Na2CO3), and pH 10 for 45 min at 90°C by using a liquor ration of 1:30. After that, the fabric was thoroughly washed, dried and conditioned (Clark, 2011).

2.2.3. Hydrogen Peroxide Bleaching

The degummed silk fabric, after the soap treatment process, was bleached in the Auto-Chroma IR infrared dyeing machine prepared using 20 ml/l of hydrogen peroxide (30% w/v) and 2-3% of sodium silicate at pH 9 for 60 min at 90°C having liquor ratio of 20:1. Then the fabric was thoroughly washed, dried and conditioned (Châu, 1987).

2.3. Test Methods

Weight was determined by using 420H electronic

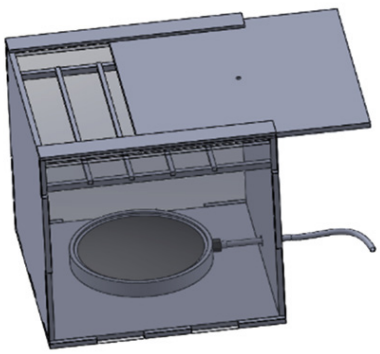

Figure 2. Applicator for Ozone Treatment

Figure 3. PC57L-16 Ozonation Apparatus

Table 1. Change in Properties of Ozone-Treated Samples (50% Wet Pickup)

pH	4			5		
Treatment Time	10'	20'	30'	10'	20'	30'
Weight	-21.06	-22.7	-23.8	-23.1	-24.4	-25.4
Breaking strength	-5.7	-7.6	-7.8	-12.3	-13.7	-14.4
Brightness	+4	+5	+5.9	+4.3	+4.8	+4.8

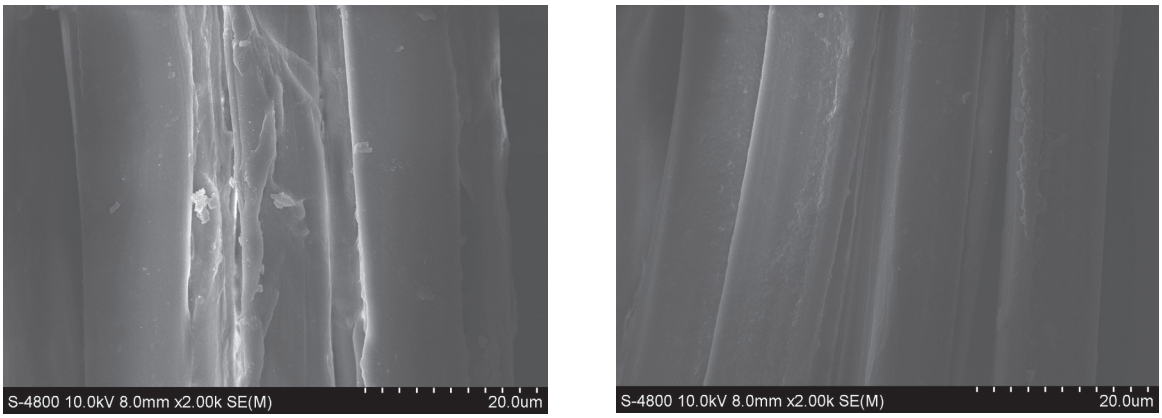

Figure 4. Surface of Raw Sample (Left) and Ozone Treated Sample (Right)

Table 2. Comparison Between Ozone Treatment with Soap Degumming and Hydrogen Peroxide

Properties	Soap Degumming	Ozone treatment (pH 4, 30'TT, 50% WP)	Bleaching by Hydrogen peroxide
Weight	-23.8	-23.8	-3.8
Breaking strength	-6.1	-7.8	-14.2
Brightness	6	5.9	4.2

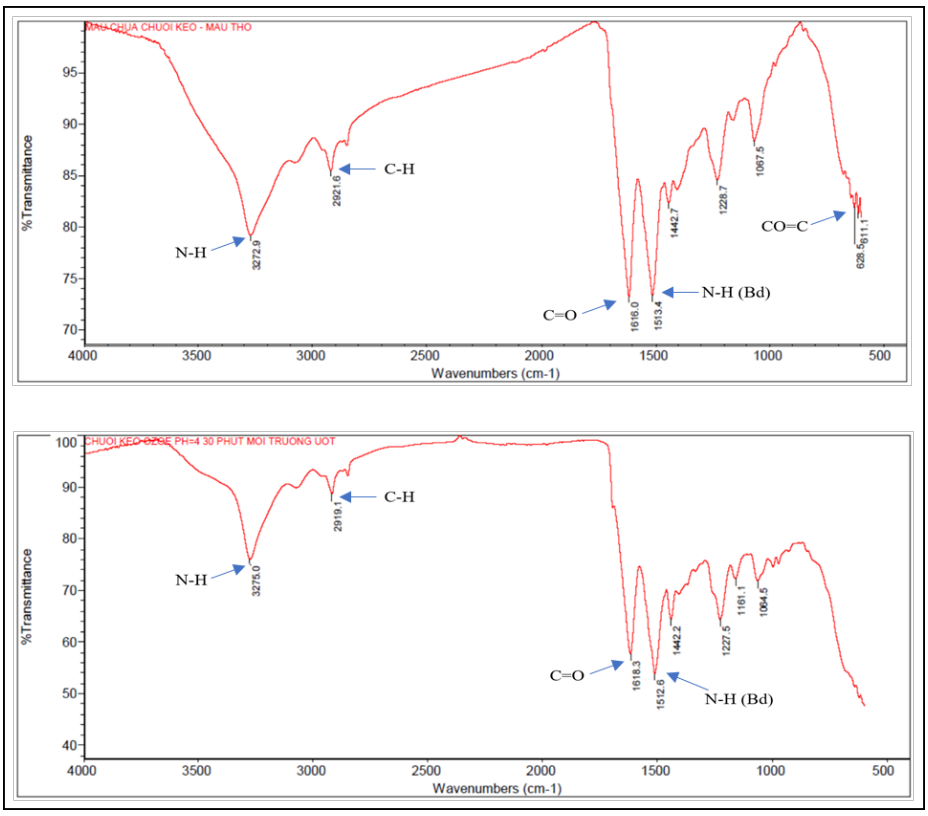

Figure 5. Infrared Spectra of Raw and Ozone-Treated Samples

scales. Breaking strength was found out in warp way with TITAN4 universal strength tester. The brightness of the samples was calculated using an X-Rite Color i5 spectrophotometer.

The scanning electron microscopy Hitachi S- 4800 was employed to capture the image of selected samples.

3. Result and Discussion

The effect on the properties of the ozone-treated silk fabric is clearly indicated in table 1. It was calculated as a percentage change, in which a negative or positive sign indicates a decrease or an increase, respectively, compared to pre-treatment. It can be clearly seen that by increasing pH and treatment time, the result releases that the breaking strength is getting worst while the brightness is increased by +5.9. The best result was achieved at pH 4, 30 minutes treatment time, and 50% wet pickup rate. It is seen from scanning electron micrographs (Figure 4.) that a certain amount of sericin was eliminated while the fibroin was not damaged.

It is also clearly shown in table 2 that the quality of silk degummed by soap is not significantly different from that of ozone treatment. The weight and breaking strength are decreased while the brightness is increased with similar percentages. In terms of bleaching, we can see that all the properties of the sample treated by ozone are better than that of hydrogen peroxide.

A study on this technique (Selvakumar & Sargunamani, 2006) demonstrated that the weight loss that occurs in ozone treatment is due to the removal of gaseous products such as ammonia, and carbon dioxide, and aldehyde, ketones and nitrates . The breaking strength decreases because of the generation of new amino groups, as indicated by infrared spectra (see Figure 5). The brightness of the fabric increased due to the removal of impurities such as dirt, oil, wax, ester solvents, ethyl alcohol, and colorants.

4. Conclusion

The result indicated that ozone treatment has influenced silk properties such as breaking strength, weight loss, and brightness of fabrics. The treatment parameter with pH 4, 30’ treatment time, and 50% wet pickup rate was found as the optimum condition for ozone treatment. In this study, the ozone technique is possible to eliminate a certain amount of sericin in the silk fabric, and also meet the permission range of silk bleaching. In addition, desired compound fibroin on silk contents remains stable quality. Therefore, ozone treatment should be considered a suitable method for degumming and bleaching silk fabric. It is also an environmentally friendly process for fabric finishing, especially for sensitive protein materials. The method can be studied further to apply on an industrial scale.

References

Aniş, Ç. T., Çapar, G., Toprak, T., & Yener, E. (2016). SERICIN REMOVAL FROM SILK FIBERS WITH ECO-FRIENDLY ALTERNATIVE METHODS. TEKSTİL ve KONFEKSİYON, 368-374.

Babu, K. (2019). 5 - The dyeing of silk. In K. M. Babu, Silk Processing, Properties and Applications (pp. 109-128). Woodhead Publishing.

Châu, P. T. (1987). Xử lý hoàn tất tơ tằm. Ho Chi Minh: Phân viện dệt may TP.HCM.

Clark, M. (2011). Handbook of Textile and Industrial Dyeing. Woodhead Publishing.

Kunz, R. I., Brancalhão, R. M., Ribeiro, L. d., & Natali, M. R. (2016). Silkworm Sericin: Properties and Biomedical Applications. BioMed Research International, 1-19.

Selvakumar, N., & Sargunamani, D. (2006). A study on the effects of ozone treatment on the properties of raw and degummed mulberry silk fabrics. Science Direct, 91(11), 2644-2653.

Sobajo, C., Behzad, F., Yuan, X.-F., & Bayat, A. (2008). Silk: A Potential Medium for Tissue Engineering. Eplasty, 437-446.

Trivedy, K., & Kumar, N. (2007). The silk proteins, sericin and fibroin in silkworm, Bombyx mori Linn. - A review. Caspian Journal of Environmental Sciences, 63~76.

TECHNOLOGY TRENDS

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Introduction to Hydroponic Farming 04

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Highlight

- Hydroponic is an agricultural farming technique that is way more advance than the conventional mean of vegetable farming.
- Beneficial for both small and large-scale vegetable farming in terms of quality, productivity, and ease of growing.
- Hydroponic farming is applicable for all seasons.

1. Introduction

The Covid-19 pandemic brought forth a shortage of labor force in vegetable farming, which severely affected the harvesting of the crop and consequently increased the demand for importing vegetables from overseas. For this reason, adaptation and improvement of agricultural technologies are needed to enhance the productivity and quality of crops for semi-commercial farming systems, likes Cambodian conditions. Various agricultural technologies and practices have been adopted to maximize productive capacity, such as climate-smart agriculture, greenhouse farming, organic farming, hydroponic farming, and so forth (Piseth, et al., 2021).

Among these existing technologies, hydroponic has been seen as an interesting technology for growing and supplying vegetables in the Covid-19 pandemic era. Hydroponic farming is widely known as a technique for growing plants without a soil medium. The root of the plant makes direct contact with the water solution pre-mixed with 16 elements of plants' essential nutrients (Table 1). Normally, hydroponic farming uses wood fiber, coir, polystyrene material, plastic, and peat to support plant roots (Benton & Jones, 2005; Resh, 2013, 2015).

Hydroponic is accepted for growing vegetables and ornamental plants, mainly herbs. As soil quality has been contaminated due to chemical fertilizers and pesticides, hydroponic farming has become more popular than ever (Dholwani, et al., 2018; Piseth, 2020).

2. Advantages and Disadvantages of Hydroponic Farming

Hydroponic farming has been seen adopted by Cambodian farmers and smallholders for vegetable growing for daily consumption and commercial purposes. This type of farming can be done in all seasons throughout the year. This technique has both pros and cons (Benton & Jones, 2005; Resh, 2015; Roberto, 2003) as described below:

Advantages

- The growing process is easy and does not require a big space
- Less labor usage
- Less water consumption
- Plant growth is twice faster than soil culture
- High-yielding quantity and quality
- Reduce time between harvest and increase nutrition value
- Plant growth environment could be reasonably well managed
- Limited chemical pesticides for weed and pest management
- Plants could be grown year-rounded
- Nutrients are ready to be uptake by plants
- Limited leaching of nutrients as compared to planting on a soil medium
- Plant products are much safer for consumers in terms of both chemical and foodborne disease issues

Disadvantages

- Installation materials and maintenance could be costly
- Require consistent electricity supplies to operate water pumps, lamps, ventilation, and etc
- Require more skills for monitoring and maintaining the systems
- Higher risks of waterborne diseases such as bacterial and water mold (oomycetes)
- No root protection layer from pests and temperature
- Low oxygen supply for the root system, if without good aeration tools

3. Growing System

Figure 1. and Figure 2. below indicate two common systems for hydroponic farming:

a) Nutrient Film Technique (NFT): is a prevalent technique as it is easy for smallholders to design and install. It is suitable for fast-growing crops such as lettuce and brassica crops.

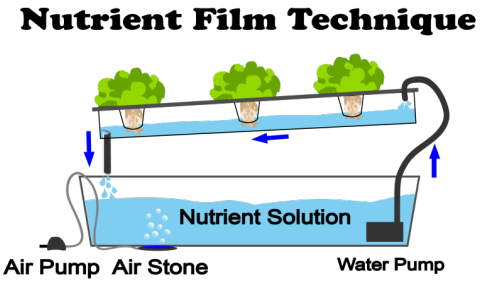

Figure 1. Nutrient Film Technique

The nutrient solution in the NFT was continual to all plants through the circulating solutions containing essential nutrients (Jill, 2021).

b) Floating hydroponic: like NFT, floating hydroponic uses bigger and deeper trays that could hold more nutrient solutions (Blog Hydroponic Urban Gardening, 2019).

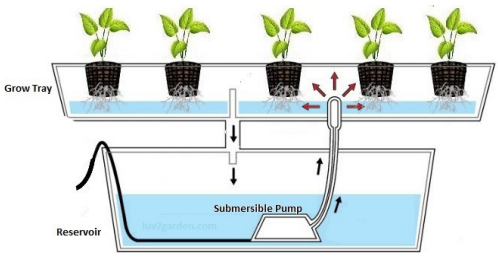

Figure 2. Floating Hydroponic

4. The Nutrient Solution for Hydroponic

Hydroponic farming requires thorough control over the nutrient solution to ensure both high quantity and quality of produces. Below are nutrients and their recommended concentration for the hydroponic system (Benton & Jones, 1985).

Table 1. 16 Elements of Nutrient Solution.

Element	Uptake Form	Concentration Range (ppm)
Carbon (C)	CO_2	-
Hydrogen (H)	H^+, OH, H_2O	-
Oxygen (O)	O_2	-
Nitrogen (N)	NO_3-, NH^{4+}	100 to 200
Phosphorus (P)	HPO_4^{2-}, H_2PO_{4-}	30 to 15
Potassium (K)	K^+	100 to 200
Calcium (Ca)	Ca^{2+}	200 to 300
Magnesium (Mg)	Mg^{2+}	30 to 80
Sulfur (S)	SO_4^{2-}	70 to 150
Boron (Br)	H_3BO_3, BO_3^-, $B_4O_7^{2-}$	0.03
Chlorine(Cl)	Cl^-	-
Copper (Cu)	Cu^{2+}	0.01 to 0.10
Iron (Fe)	Fe^{2+}, Fe^{3+}	2 to 12
Manganese (Mn)	Mn^{2+}	0.5 to 2.0
Molybdenum (Mo)	MoO_4^{2-}	0.05
Zinc (Zn)	Zn^{2+}	0.05 to 0.50

Note: the value of C, H, and O is not shown in the table as it is varied based on the amount of water and atmosphere condition, while there is little demand for Cl quantity within the growing process.

5. Recommendation

Growers need to monitor water pH, electric conductivity (EC), temperature, and air humidity carefully. A pH meter could be used to monitor the pH level, which is recommended between 5 to 6, or to save some cost, pH papers could be used. EC is an indicator of salinity in the water, while the optimal range for hydroponics is between 2000 and 4000 µS/cm. The water temperature should be between 20°C and 25°C (Piseth, 2020).

Reference

Benton, & Jones, J. (1985). Growing Plants Hydroponically. In American Biology Teacher (Vol. 47). https://doi.org/10.2307/4448083

Benton, & Jones, J. (2005). Hydroponics A Practical Guide for the Soilless Grower Second Edition. In J. B. Jones (Ed.), Hydroponics: A Practical Guide for the Soilless Grower Second Edition. Retrieved from https://www.routledge.com/Hydroponics-A-Practical-Guide-for-the-Soilless-Grower-2nd-Edition/Jones-Jr/p/book/9780429122309

Blog Hydroponic Urban Gardening. (2019). Various hydroponics systems. Retrieved August 25, 2022, from Hydroponic website: https://www.hydroponic-urban-gardening.com/hydroponics-guide/various-hydroponics-systems/

Dholwani, S. J., Marwadi, S. G., Patel, V. P., & Desai, V. P. (2018). Introduction of Hydroponic system and it's Methods. International Journal for Research Trends and Innovation (Www.Ijrti.Org), 3(3), 69. Retrieved from www.ijrti.org

Jill, S. (2021). Hydroponic Nutrient Film Technique (NFT) System Setup and Guide. Retrieved August 25, 2021, from Hydroponic website: https://constantdelights.com/post/nutrient-film-technique#:~:text=The nutrient film technique is a hydroponic growing,roots of the plants to stay constantly submerged.

Piseth, M. (2020). solar hydroponics and aquaponics (No. 247). Retrieved from https://elibrary.maff.gov.kh/book/603da8f1be7dc

Piseth, S., Monyoudom, Y., & Tynarath, H. (2021). Cambodia's Agri-Food Trade: Structure, New Emerging Potentials, Challenges & Impacts of Covid-19. In FOOD SECURITY POLICY RESEARCH, CAPACITY, AND INFLUENCE (PRCI) RESEARCH PAPERS (Vol. 5). Retrieved from https://www.canr.msu.edu/resources/cambodia-s-agri-food-trade-structure-new-emerging-potentials-challenges-impacts-of-covid-19

Resh, H. M. (2013). HYDROPONIC Food Production. A Definitive Guidebook for the Advanced Home Gardener. In CRC Press. Retrieved from https://www.taylorfrancis.com/books/9781439878699

Resh, H. M. (2015). Hydroponics for the Home Grower. In Hydroponics for the Home Grower. https://doi.org/10.1201/b18069

Roberto, K. (2003). How-To Hydroponics. In Keith Roberto (Ed.), www.howtohydroponics.com (4th ed.). The futuregarden Press adivision of Futuregarden, Inc 97 Rome Street Farmingdale, New York 11735.

DIGITAL Transformation for Public Works and Transportations in Cambodia

05

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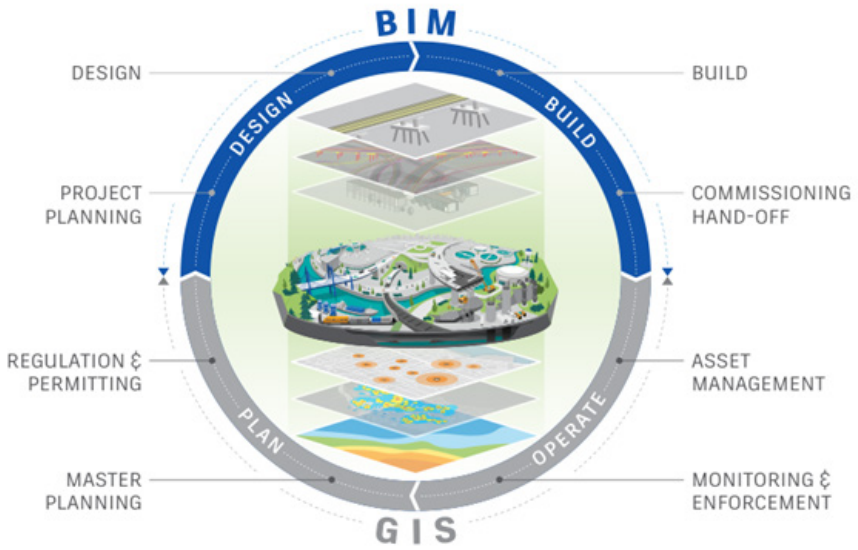

Figure 1. Integrating BIM and GIS- Data at the Center

Highlight

• Senior Minister of MPWT, H.E Sun Chanthol, remarked at a World Economic Forum event held via video conference on June 29 under the theme “Recovery of Business Activity: Revitalizing the Regional Economy with a Sustainable Supply Chain.” Addressing world leaders at the event, he highlighted the Kingdom’s “readiness” to embrace the regional digital economy. “Cambodia has prioritized on promoting digital systems to ensure the smooth flow of goods, services, skills, capital, and data. The Kingdom needs to focus on legal and institutional cooperation to more effectively adapt to the digital revolution in trade, investment, trade facilitation, small and medium enterprises, and skills development,” he said.

• In order to achieve these above goals, H.E Sun Chanthol, has in recent years, made it a top priority that the MPWT would become one of the pioneers in not only digitizing the important data and information but also digitalizing the processes in the tactical and strategic management and administration of the transportation infrastructures, namely, roads, aviation, maritime, inland waterways, railways, public services like vehicle registration. Moreover, this all paves the way for the eventual digital transformation of the MPWT in the fast-realizing Industry 4.0 Revolution.

1. Transforming Infrastructure in Planning, Design, Construction, Operation & Maintenance (O&M)

Governments around the world need to invest $57 trillion in infrastructure through 2030 to keep up with global GDP growth, according to McKinsey. That is a massive incentive for the AEC industry to improve productivity and speed up project delivery. Construction is ripe for disruption, and two of the technologies playing a central role in its transformation are Building Information Modeling (BIM) and Geographic Information Systems (GIS).

Evidence has been mounting for years that BIM-driven 3D modeling and data visualization are essential for major urban construction projects. However, before the pandemic, the World Economic Forum estimated that only around a third (PDF, p. 4) of infrastructure, and public works firms had fully integrated BIM tools into their operating models.

• *Project Handover Process*

The GIS specialist receives raw BIM or CAD data. Then, they must update and manipulate it manually in preparation for importing it into a GIS database. The flow of information usually goes in one direction, which is not taking advantage of project data across workflows.

• *Outdated Data*

The likelihood of human error in the manual data input process can result in the loss of critical information. Exporting data manually also makes it "outdated" in sense, since it can no longer be accessed directly by the BIM or CAD program from which it originated.

• *Nonauthoritative System of Records*

Projects teams might incorporate GIS data that is not connected to an authoritative system of record, and so designs may be based on inaccurate and out-of-date information.

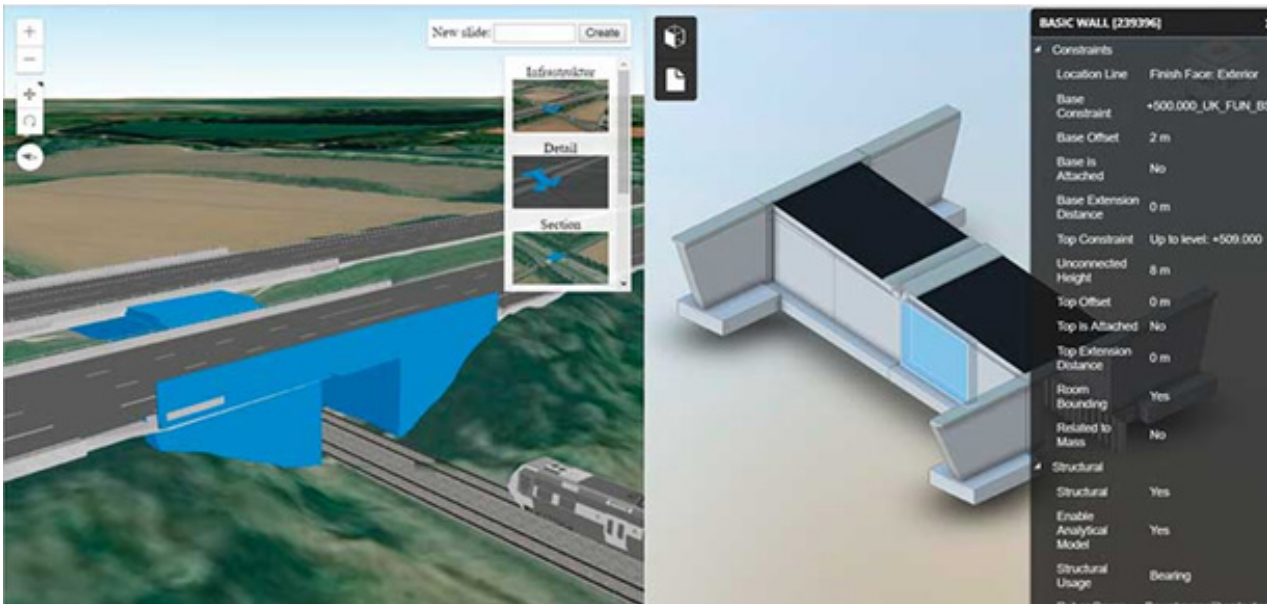

Figure 2. Esri and Autodesk are already Experimenting with Integration Options such as this Prototype Integration of the ArcGIS Online and Autodesk BIM 360 Web Viewers

The rest are missing out on better collaboration between project partners, cost and resource savings, shorter project lifecycles, improved building management and safer construction sites.

The current ways of working between BIM and GIS teams hamper our ability to meet global trends.

These processes are prone to not just inefficiencies but also critical data loss, leading to increased risks. The BIM data formats used by key government departments are a patchwork with disparate objects holding back interoperability and collaboration. These inefficient ways of working are key drivers to help integrate BIM and GIS data and technologies.

2. A New Approach: Data at the Center

MPWT is working to promote and advance BIM and GIS for Infrastructure as a digital conduit of information between the design, construction, and O/M of an infrastructure asset. Increased access to and better integration of geospatially located data will increase the team productivity and efficiency of project delivery.

3. Current Tools and Technology for Integration of GIS and BIM

Esri's work with Autodesk will include transforming the project life cycle, providing the continuous context of the site and the environment around BIM projects, and detecting site change. In addition, improvements are planned for the overall process of designing and visualizing the real world in 3D and building technologies to help optimize infrastructure operation. Ultimately, Esri's work will encourage the use of its open platforms for innovation and sharing.

Esri has made progress in providing an open platform for the data flow. Its significant contributions to 3D technology and standards should drive innovation associated with BIM-GIS integration and, more broadly, GIS. After several years of research and development, Esri released Indexed 3D Scene Layers (I3S), under Creative Commons licensing as an open specification in April 2015. An Open Geospatial Consortium, Inc. (OGC) Community Standard, I3S enables the distribution of large 3D datasets over the Internet and on local devices.

Bentley Systems Incorporated can create I3S data with its product ContextCapture, and users can publish and access the data in ArcGIS Online through Esri's open ArcGIS REST API (GeoService REST). Esri is looking forward to further collaboration with Autodesk, Bentley, and other industry leaders to help simplify workflows and improve outcomes for the GIS users.

4. Conclusion

1. MPWT is on its way to establish the national transportation infrastructure policy and strategic plan for the short and long-term vision keyed on the digital transformation in response to the 4th Industrial Revolution national strategic road map (national policy) 2022-2025 and long-term vision 2035 on "Planning/ Programming, Design, Construction, O&M, Retirement/ Decommissioning of transportation infrastructure systems to respond to the Fourth Industrial Revolution."

2. This policy and strategic plan will be in alignment with the missions and objectives outlined in the "Cambodia Digital Economy and Society Policy Framework 2021-2035" and "Cambodia Digital Government Policy 2022-2035," and they will be based on BIM GIS and adopting Open Technologies to ensure a digital ecosystem that is strong and resilient to various crises and timely response to the fast-moving development of digital technology.

References

Building Information Modelling (BIM) for road infrastructure: TEM requirements and recommendations,Trans-European North-South Motorway (TEM),UNITED NATIONS ECONOMIC COMMISSION FOR EUROPE.

Cambodia Digital Economy and Society Policy Framework 2021-2035.https://mef.gov.kh/download-counter?post=7116

Cambodia Digital Government Policy 2022-2035. https://asset.cambodia.gov.kh/mptc/media/Cambodia_Digital_Government_Policy_2022_2035_English.pdf

STI POLICY

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CAMBODIA Enterprise Innovation Index: A Conceptual Framework

06

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Highlight

• This study is concerned with developing enterprise innovation index for measuring innovation inputs and outputs of firms, identifying challenges and opportunities in Cambodia's innovation ecosystem, and giving evidence-based recommendations to innovation policymakers.

• Built on the Global Innovation Index (GII), the IMD World Competitiveness Ranking, and the Global Competitiveness Index (GCI), the study presents a conceptual framework of the Cambodia Enterprise Innovation Index (CEII) for which input and output sub-indices are the main dimensions.

• The input sub-index comprises four pillars, namely the "Culture" pillar, which captures the organizational culture of firms that is conducive to innovation; the "Resources" pillar looking into firms' use of human, data, and financial resources to enable innovations. The "Competence" pillar capturing firms' capability to bear fruits of innovation; and the "Network" pillar that scrutinizes firms' internal and external collaboration for innovations.

• Within the output sub-index are two pillars, including the "Knowledge and technology outputs" pillar that takes into account firms' knowledge creation and technological achievements; and the "Creative outputs" pillar that gauges firms' both tangible and intangible creative products and services, as well as online creativity.

1. Background and Introduction

Innovation is central to improvements in living standards and can affect individuals, institutions, entire economic sectors, and countries in multiple ways (OECD/Eurostat, 2018). Many nations with, whether developing or developed economies are looking to improve their innovative capability aiming for enhanced productivity and economic growth. Cambodia is of no difference. Recognizing the significance and potential of innovation as a tool for achieving the country's Vision 2050, Cambodia put out the National Science, Technology & Innovation (STI) Policy 2030 in 2019. Moreover, shortly after, Cambodia's STI Roadmap 2030 was developed with the purpose of guiding government ministries and relevant stakeholders on actions to take in the short and medium terms until 2030 and as well as for the implementation of the National STI Policy (MISTI, 2021).

Under the first pillar of Cambodia's STI Roadmap, "Improving the governance of the national innovation system," conducting a firm-level survey on innovation performance is among numerous actions and instruments proposed to achieve the set policy targets. The availability of more data about innovation performance and impacts through charting the innovation index helps developing countries in the catching-up process and in assessing what they should do to boost innovation. Further, the innovation index highlights policy challenges – national policies to craft new national innovation strategies (Wonglimpiyarat, 2010).

2. Literature Review

According to the Oslo Manual 2018, innovation is a new or improved product, or business process (or a combination thereof) that differs significantly from the firm's previous products or business processes and that has been introduced on the market or brought into use by the firm. In this regard, the innovation index ranks economies, or selected actors in those economies (institutions, researchers or businesses) as per their innovative capability and performance. From this definition, the innovation index can help measure the national innovation capability, identify contributing and hindering factors, challenges and opportunities, promote innovation culture and improve overall innovation ecosystems. On top of that, it also functions as a tool for measuring innovation performance over time and as a benchmark of national capability highlighting the resource commitments and policy choices that mostly affect innovative output in the long run (Porter & Stern, 1999).

2.1 The Global Innovation Index (GII)

First launched in 2007 by the European Institute of Business Administration (INSEAD), the Global Innovation Index (GII) is one of the major indices that aim to find and determine metrics and methods that could capture a picture of innovation in society that is as complete as possible (WIPO, 2021). Fig. 1 highlights the GII framework, which comprises two sub-indices, the innovation input sub-index (Institutions, Human capital and research, Infrastructure, Market sophistication, and Business sophistication) and the innovation output sub-index (Knowledge and technology outputs, and Creative outputs).

2.2 The IMD World Competitiveness Ranking

The International Institute for Management Development (IMD) is another key player that has developed a competitiveness ranking for measuring the ability of countries to manage their resources and competencies to enable the creation of values in the long term. Table 1 shows four major competitiveness factors rolled out by IMD to measure the innovative capability, and performance of nations. The factors comprise economic performance, government efficiency, business efficiency, and infrastructure.

2.3 The Global Competitiveness Index (GCI)

In the context of competitiveness factors, the Global Competitiveness Index (GCI), published annually by the World Economic Forum, has also developed factors supporting innovation and business competitiveness. Table 2 shows those factors, including enabling environment, human capital, markets, and innovation ecosystem, which further consist of subsequent pillars. The enabling environment factor comprises institutions, infrastructure, ICT adoption, and macroeconomic stability, while the human capital factor comprises health and skills. For the market factor, there are product market, labor market, financial system, and market size pillar. Last but not least, the fourth major factor, the innovation ecosystem, consists of business dynamism and innovation capability.

Table 1. The IMD Competitiveness Factors. IMD World Competitive Booklet 2022.

Factors	No. of Criteria	Description
Economic Performance	82	Macro-economic evaluation of the domestic economy: Domestic Economy, International Trade, International Investment, Employment, and Prices.
Government Efficiency	72	The extent to which government policies are conducive to competitiveness: Public Finance, Fiscal Policy, Institutional Framework, Business Legislation, and Societal Framework.
Business Efficiency	74	The extent to which the national environment encourages enterprises to perform in an innovative, profitable, and responsible manner: Productivity and Efficiency, Labor Market, Finance, Management Practices and Attitudes and Values.
Infrastructure	106	The extent to which basic, technological, scientific, and human resources meet the business needs: Basic Infrastructure, Technological Infrastructure, Scientific Infrastructure, Health and Environment, and Education.

Table 2. The GCI Framework. The Global Competitiveness Report 2019. World Economic Forum (WEF).

Factors	Pillars
Enabling environment	Institutions Infrastructure ICT adoption Macroeconomic stability
Human capital	Health Skills
Markets	Product market Labour market Financial system Market size
Innovation ecosystem	Business dynamism Innovation capability

3. Cambodia Enterprise Innovation Index (CEII)

3.1 Goal

The Cambodia Enterprise Innovation Index (CEII) aims to “promote innovation and enhance innovation capability and achievements of Cambodian enterprises.”

3.2 Objectives

The CEII intends to:

- Provide a set of metrics for assessing the innovation inputs and innovation outputs of Cambodian enterprises;
- Provide the methodology to calculate the total innovation index score;
- Rank all enterprises based on their innovation index score;
- Identify opportunities and challenges, and give recommendations to innovation policymakers.

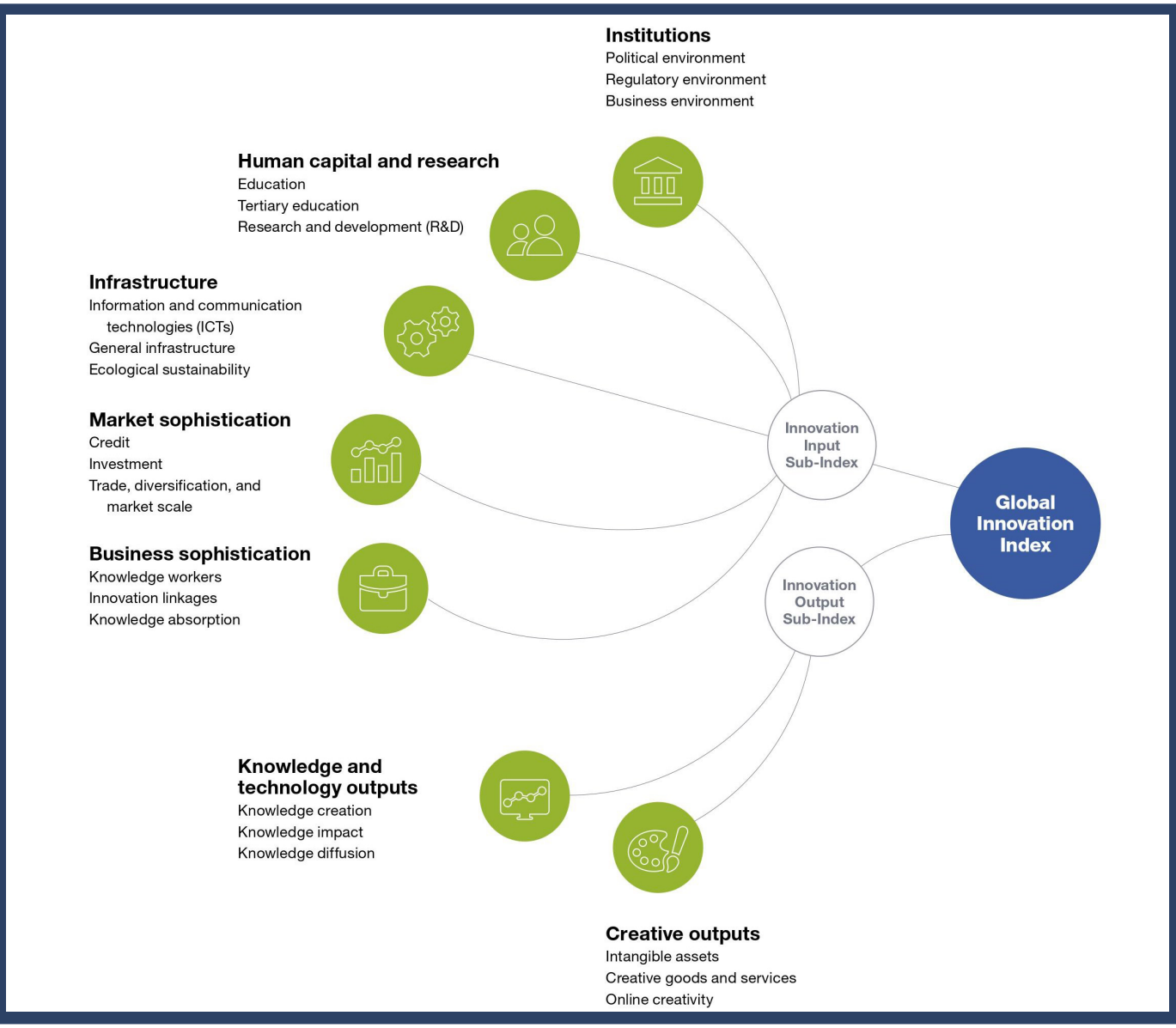

Figure 1. The Global Innovation Index Framework. Global Innovation Index 2021. WIPO.

3.3 Conceptual Framework

Built on the Global Innovation Index (GII), the IMD World Competitiveness Ranking, and the WEF's Global Competitiveness Index, the Cambodia Enterprise Innovation Index (CEII) comprises two major dimensions, namely innovation input sub-index and innovation output sub-index. Within the innovation input sub-index, there are four main pillars such as culture, resources, competence, and network. On the other hand, the innovation output sub-index consists of two pillars being knowledge and technology outputs, and creative outputs. Fig. 2 highlights the framework of the Cambodia Enterprise Innovation Index (CEII).

The CEII will produce four measures which are the innovation input sub-index score, innovation output sub-index score, the total innovation index score, and the innovation efficiency ratio. The four pillars under the input dimension capture the investments, infrastructure and environment of enterprises that are conducive to innovation activities. Innovation outputs (knowledge, technology, and creative outputs) are fruits of the innovation activities conducted by firms. The total innovation index is calculated as a simple average of the two sub-indices, while the innovation efficiency ratio is

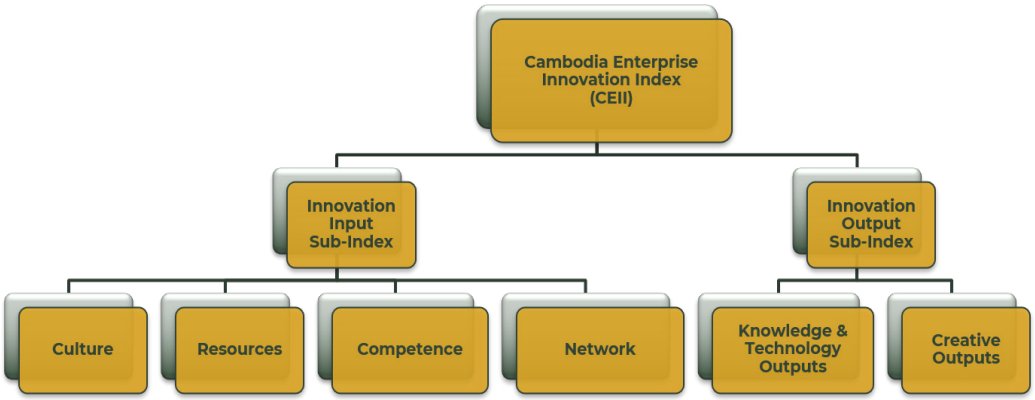

Figure 2. The Cambodia Enterprise Innovation Index (CEII) Framework

a ratio of the aforementioned two sub-indices measuring the enterprises' ability to get the most from their innovation inputs.

4. Conclusion

The Cambodia Enterprise Innovation Index will accomplish more than just collecting innovation data. It provides metrics and methodology for capturing the holistic aspects of innovation within firms in order to constantly improve their innovative capability and results. Enterprises themselves can easily use this index as a guiding principle when it comes to making investments, building infrastructures, formulating organizational culture, and conducting activities for innovation. Furthermore, it is expected that not every enterprise will excel at every pillar of the index. Therefore, they can learn from the best practices and avoid mistakes or shortcomings of each other. While an index seems to fuel competition which is beneficial for building and maintaining competitiveness, the CEII will also promote a collaborative culture between enterprises. Once actors in our economy are competing and collaborating simultaneously for growth, Cambodia's Vision 2050 is nowhere but in reach.

References

IMD World Competitiveness Center. (2022). IMD World Competitiveness Booklet 2022.

MISTI. (2021). Cambodia's Science, Technology & Innovation Roadmap 2030.

M.E. Porter, S. Stern, The New Challenge to America's Prosperity: Findings from the Innovation Index, Council on Competitiveness, USA, 1999.

Oecd, & Eurostat. (2018). Oslo manual 2018: Guidelines for collecting and interpreting innovation data on innovation.

WIPO (2021). Global Innovation Index 2021: Tracking Innovation through the COVID-19 Crisis. Geneva: World Intellectual Property Organization.

Wonglimpiyarat, J. (2009). Innovation index and the innovative capacity of nations. Futures, 42(3), 247-253.

World Economic Forum, & Schwab, K. (2019). The global competitiveness report 2019. Oxford University Press, USA.

STEM
EDUCATION & CAREERS

Operation Chou Li, Find Earth's Axis Tilt from Ancient Khmer Prasat Phupek, Sakon Nakhon, Thailand

07

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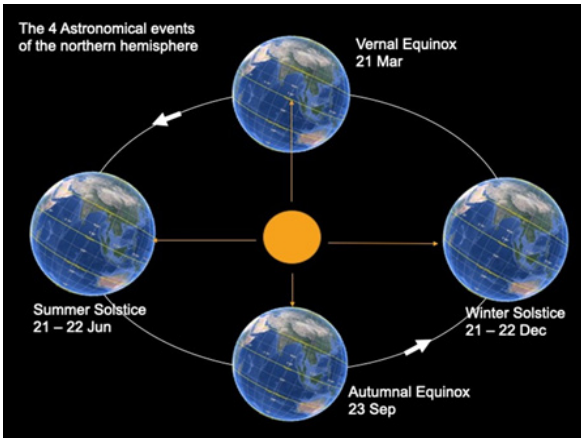


Figure 1. The 4 Important Astronomical Events of the Northern Hemisphere. Adapted from: David (2014).

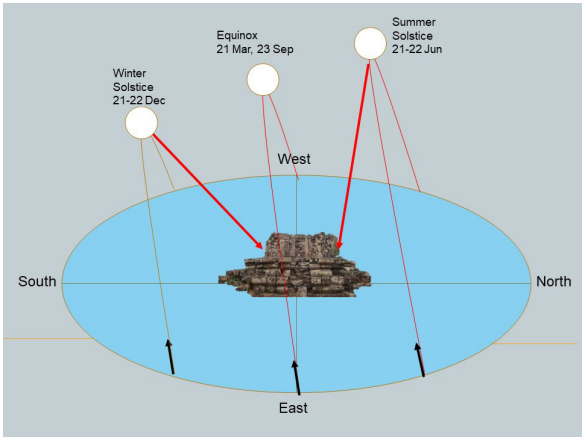


Figure 2. The Prasat Phupek Temple has Full Astronomical Properties. It Can Show the Angle of the Sun's Fall in All Astronomical Events. (Latitude: 17° 11' 19.20" N; Longitude: 103° 56' 8.39" E).

Highlight

• This study aims at promoting STEM Education by empirically applying the scientific knowledge contained in the textbooks, making science more engaging and memorable, especially to change the view of visiting Khmer ancient temples, not only about emphasizing the history, but also more focusing on scientific and engineering concepts behind those great ancient temples.

• Using the combination of Chou Li's approach and Pythagoras' theory, we processed it into an equation to find Earth's axis tilt. The experiment was conducted at the ancient Khmer Prasat Phupek. It was shown that the calculated Earth's axis tilt was 23.6259 degrees with only 0.8% error compared to the current Earth's axis tilt of 23.44 degrees.

• The ancient Khmer temple called Prasat Phupek can be employed as an accurate astronomical device colored with impressive and unforgettable legendary behind. Thanks to the ancestors who built this temple with inscribed astronomical traces on the wall. The author gave her a title of a thousand-year-old "Astronomical Hard Disk". Last but not least; hopefully this study can be useful to those individuals who love to learn something called out-of-the-box knowledge.

1. Why the Name "Operation Chou li"?

When it comes to Earth's axis tilt, it has been known for a long time. The first reasonably accurate measurements were made in China and India. The first that we know was made in 1100 B.C. (over 3000 years ago) by Chou Li, and the next set of measurements came from Greek geographers about 750 years later (Kristine, 2015). Therefore, the author honorably credited the name Chou Li in this astronomical operation at ancient Khmer Prasat Phupek on the top of the mountain +520 meters above sea level, Thailand.

2. Why Choose Ancient Khmer "Prasat Phupek" as a Study Area?

We aim to prove that our ancestors, more than three thousand years ago, were able to calculate the angle of inclination of the Earth, even without modern equipment such as compasses and GPS. The Chou li operation used astronomical marks that appeared on the sandstone floor of Prasat Phupek, including folk equipment costing less than 1.5 dollars (made paper and rulers). In addition, the temple also has full astronomical properties as it was built to match the sun in the "equinox" phenomenon (most of ancient Khmer temples face east). This makes it easy to place the device astronomically correctly and can accurately capture the angle of the sun to Earth at noon solar time in the phenomena "winter solstice 21 December" and "summer solstice 21 June" to calculate the inclined angle of the Earth's axis according to the Pythagoras mathematical theorem.

3. What are Sumer Solstice and Winter Solstice?

Every year there are 4 important astronomical events as Vernal Equinox 21 March, Autumnal Equinox 23 September, Sumer and Winter Solstices. The summer solstice is the day that has the most daylight hours of any in the year and usually occurs on 22 June, but also can occur between 21 and 23 June whereas the winter solstice occurs once a year in December when the sun's track across the sky reaches its highest point. It is the day of the year that has the least daylight hours of any in the year. The summer solstice usually occurs on 22 December, but it also can occur between 21 and 23 December. (Eldridge, n.d.) as shown in the Figure 1, Figure 2, and Figure 3.

Figure 3. Place the Sundial to Match the True North Mark on the Sandstone Floor". The North Line of Somasutra

4. How to Calculate Earth's Axis Tilt?

We applied the approach of "Chou li" combined with the "mathematical theory of Pythagoras" and processed it into an equation as shown in Figure 4, Figure 5, anf Figure 6.

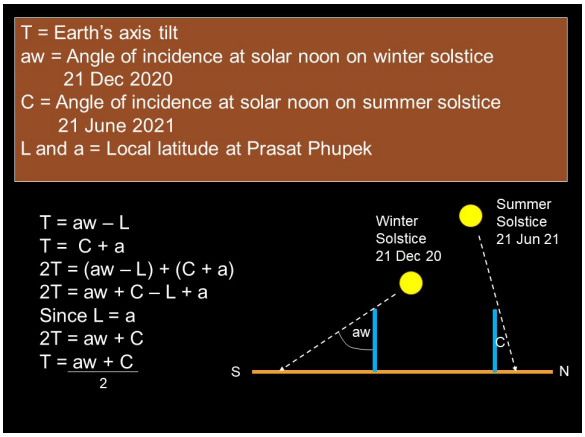


Figure 4. Formula in Calculating the Earth's Axis Tilt

Note: "Solar noon" means the sun is in its highest position that day and is at an angle that matches the true north. As a result, the sundial's shadow also corresponds to the "true north."

5. Operation Chou Li (Summer Solstice 21 June 2021)

Early morning, on June 21, 2021, at around 5:00 am, the authors and team went up to Prasat Phupek, 520 meters above sea level, to operate the Cou Li as shown in the Figure 7, and Figure 8.

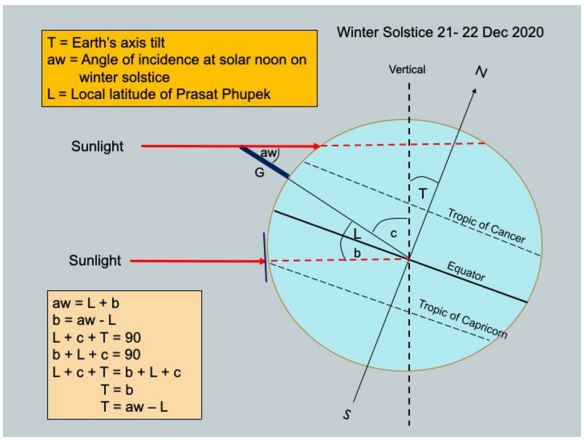


Figure 5. Calculating the Earth's Tilt Angle in the "Winter Solstice" Phenomenon on December 21

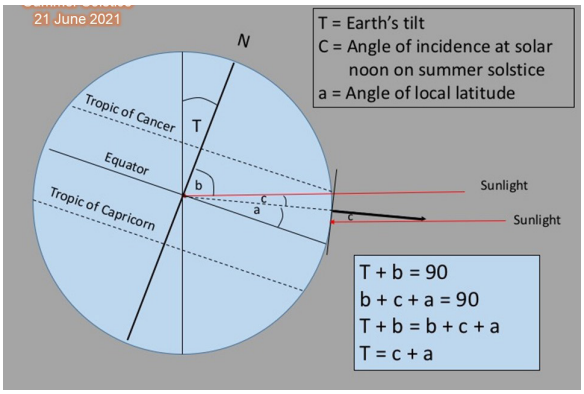


Figure 6. Calculating the Earth's Tilt Angle in the "Summer Solstice" Phenomenon June 21

Figure 7. Placed the Sundial in Line with the True North Mark of the North Door of the Temple.

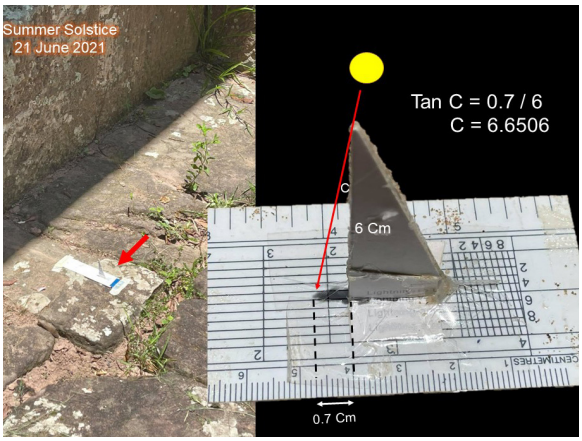


Figure 8. The Length of the Sun's Shadow at Solar Noon was Measured 0.7 cm and the Angle of Incidence was 6.6506 Degrees.

6. Operation Chou Li (winter solstice 21 December 2020)

Figure 9. Placed the Sundial on the Wall of the South Door. In the Morning, the Sun's Shadow Points to the West. The Sun's Shadow at Solar Noon Pointed Directly to the Mark on the Sandstone Wall.

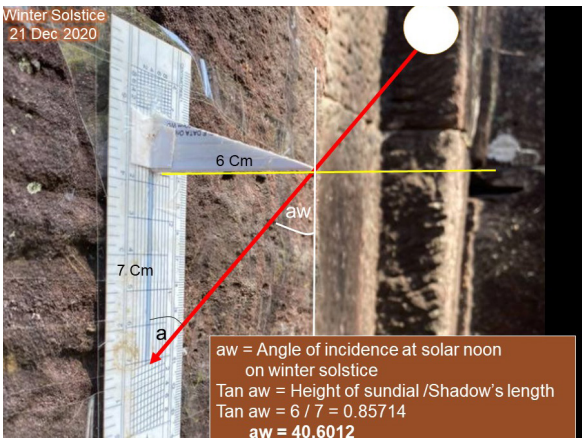
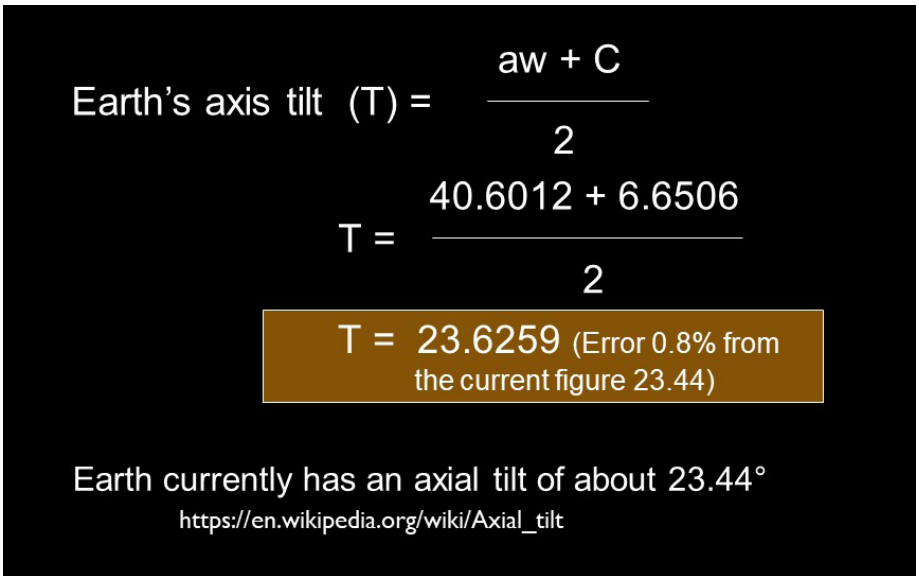


Figure 10. The Length of the Sun's Shadow was Measured 7 cm and the Sngle of Incidence was 40.6012 Degrees.

7. Earth's Axis Tilt



This calculation note is the result of the measured earth's axis tilt (T= 23.6259 degrees), and the error is only 0.8% (the current earth's tilt angle is 23.44 degrees) (WIKEPEDIA, 2021).

8. Conclusion

The result of the measured Earth's axis tilt was 23.6259 degrees with only 0.8% error compared to the current Earth's tilt angle 23.44 degrees. The ancient Khmer temple called Prasat Phupek can be employed as an accurate astronomical device colored with impressive and unforgettable legendary behind.

References

David, P. S. (2014, March 29). Seasons of the year. NASA. https://pwg.gsfc.nasa.gov/stargaze/Sseason.htm

Eldridge, A. (n.d.). What's the Difference Between a Solstice and an Equinox? Britannica.https://www.britannica.com/story/whats-the-difference-between-a-solstice-and-an-equinox

Kristine, S. (2015, July 18). Who (and when) discovered that the Earth's axis is on a 23-degree tilt? (Intermediate). Ask an Astronomer. http://curious.astro.cornell.edu/

WIKEPEDIA. (2021, June 21). Axial tilt. WIKEPEDIA https://en.wikipedia.org/wiki/Axial_tilt

Enhancing Comprehension in Physics for Lower Secondary School Students Using 3D Printing Technology

08

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Highlight

• Hands-on learning using three dimensional (3D) educational tools is a crucial role in promoting students' involvement in STEM and equipping them with adequate knowledge readily for their future careers in Science, Technology and Innovation (STI)

• To enhance students' understanding of the subject matter in physics, 3D model images of the real pilot prototype are illustrated with elaboration and technicality

• A physical prototype for demonstration is also produced by using a 3D printer. So that, lower secondary students can understand both theory and real experiments for the physics

1. Introduction

Most fundamental subjects relevant to Science, Technology, Engineering, and Mathematics (STEM) are commonly introduced within the lower secondary level. One of the main subjects that plays an important role in STEM education is physics due to its capability to extend and enhancing students' understanding of other disciplines, such as natural phenomena, how things work in real-life practice, and so on. Therefore, physics in lower secondary school is the basic foundation of all other sciences (Jackson 2016). However, Physics is too abstract and difficult to understand, especially for adolescent students, leading to a loss of interest in physics (Ornek 2008).

To solve this problem, hands on learning through visualization and physical interaction can be used to improve students' attention and comprehension of the subject. Hand-on learning refers to the use of objects to engage students' involvement, to demonstrate, and to explain the natural phenomenon of the subject (Ateş and Eryilmaz 2011). For instance, the demonstration via hands-on learning can be conducted using basic household equipment or any objects, which can be easily found on the market. However, some lessons, especially in grade 9 of secondary school, require more complex educational tools for hands-on demonstration. For example, lessons on the assembly of pulleys, gears, and electromagnetism require complex components for hands-on practice. Those components are challenging to make and many of them are not available in the market. Hence, 3D printing technology can fabricate the 3D educational tools with complex shape and mechanisms. A good

design of 3D educational tools could produce more interactive functionalities and more options for learning, which in turn improves students' attention and understanding. Therefore, hands-on learning using 3D educational tools plays a crucial role in promoting students' involvement in STEM and equipping them with adequate knowledge for future careers in Science, Technology and Innovation

2. Objective

The object of this paper is to enhance the understanding of subject matter in Physics theory by creating a prototype. To fulfill the objective, two specific objectives are set up below:

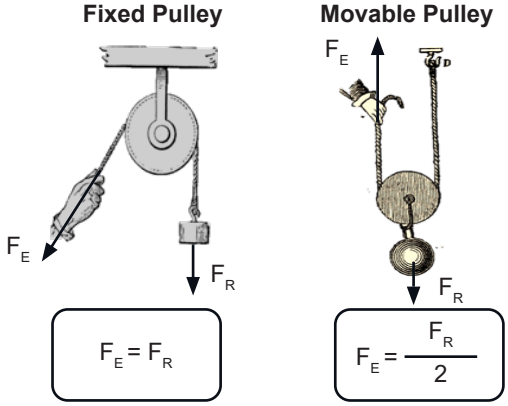
- To create three main subsystem prototypes in Physics theory through 3D printing technology
- To produce a prototype from the combination of these three main subsystems above

3. Methodology

A Prototype of the educational tool is fabricated using 3D printing technology in combination with other necessary parts (e.g., magnet, copper wire, LED lamp, etc.). The prototype consists of simple items, including pulleys, gears, and coil generators which are used for teaching grade 9 physic lessons. In addition, the combination of the three items can be used to exhibit the transfer and conversion of energy (from mechanical energy to electrical energy or vice versa) via displacement, rotational motion, and electromagnetism. This Prototype is divided into three main parts:

Part 1: Pulley cable system

Pulley is a simple machine that consists of a wheel and axle system that uses a cable, rope, or string to help lift heavy objects more easily. Three main types of pulleysystems: Fixed pulley, Moveable pulley, and Compound pulley (Rokenbok 2015).



Compound Pulley

Figure 2. Pulley

$$F_E = \frac{F_R}{2^n}$$

F_E: effort force (N)
F_R: resistance force (N)
n : number of the movable pulleys

Practice

In Figure 3, if the friction is neglected. Choose the correct answer to F_E :

A. 1.5 N
B. 2 N
C. 4.9 N
D. 9.81 N

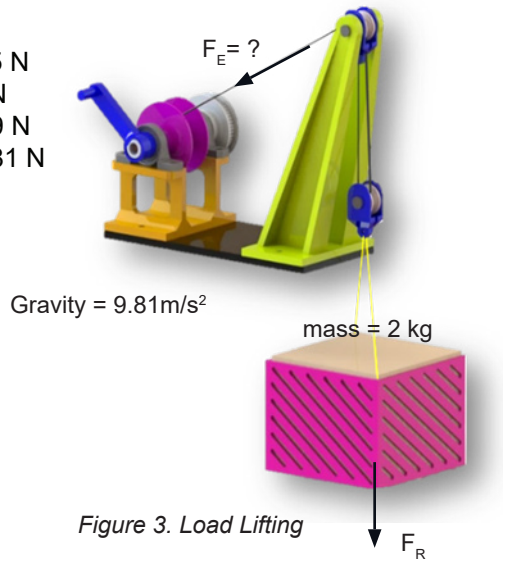


Figure 3. Load Lifting

Part 2: Gears System and Pulleys are Driven via a Belt

Gears are machine elements that transmit motion utilizing successively engaging teeth (shown in Figure 4). Gears systems operate in pairs to transmit and modify rotary motion and torque (turning force) without slip, the teeth of one gear engaging the teeth on a mating gear (Curb 2015). Belt drive is a frictional drive that uses pulleys and an elastic belt to transmit power between two or more shafts. It is usually driven by friction.

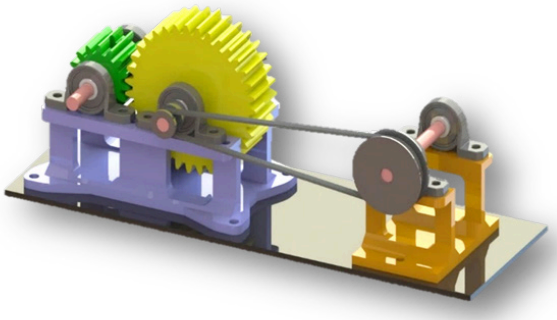


Figure 4. 3D model of Gears System and Pulleys Driven via a Belt

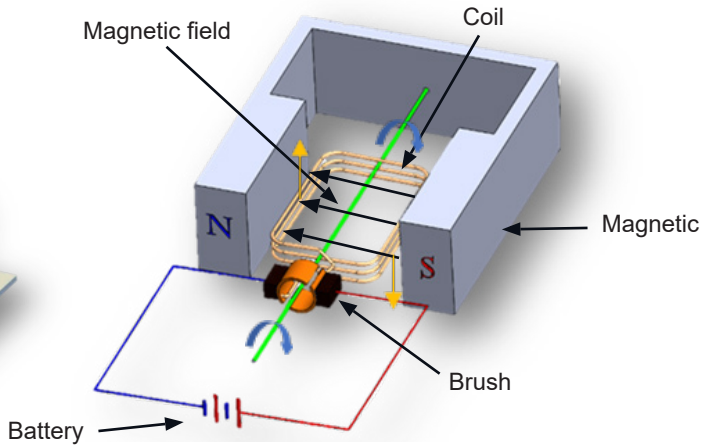


Figure 5. A Simple Motor Diagram (MoEYS n.d.)

Part 3: Electromagnetism

The physical interaction between electric charges, magnetic moments, and the electromagnetic field is known as electromagnetism (Kashy 2018). It is commonly seen in electric motors, generators, loudspeakers and so on.

A Simple Motor

As the electric current passes through the coils, an electromagnetic field is generated around it. When there is a permanent magnet around the coils (shown in Figure 5), the electromagnet's field will interact with the permanent magnet's field. The repulsion and attraction due to the interaction of the magnetic poles of an electromagnet and permanent magnets cause the coils to spin (a simple motor process).

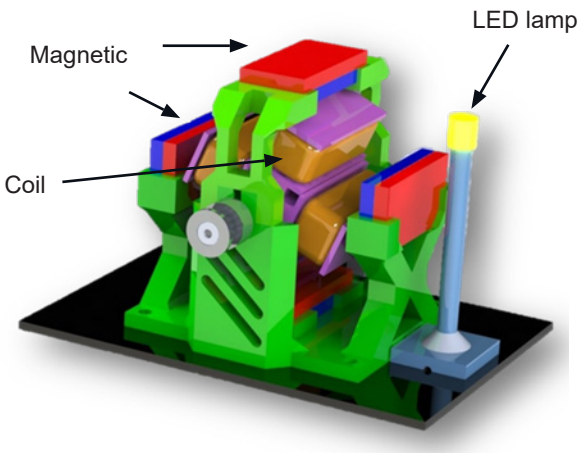


Figure 6. 3D model of Electric Motor Generator

An Electric Generator

Conversely, when the coils are rotated by an external force (pulley) inside the permanent magnet's field, as displayed in Figure 6, the changing of the magnetic field in the spinning coils induces current to flow in the wire, in turn generating electricity. Brushes and split rings are used to ensure the one-directional flow of current and generate direct current (DC) for lighting the LED lamp, as shown in Figure 6.

Combined system

The combination of the three parts above can work together to generate electricity for lighting up the LED lamp, as shown in Figure 9. Firstly, when the load of mass M pulls down the cable, it causes the pulley P1 to rotate. Then, as the pulley P1 connects to the other pulley of gear A via a belt, gear A starts to spin and rotate gear B.

The size of gear A is bigger than gear B, which consequently increases the rotation speed of pulley P2. As a result, gear P2 can spin the coils faster. It is noted that pulley P2 of gear B and pulley P3 of the electric motor generator are connected via a belt and the size of the pulley P3 is bigger than that of pulley P2. As the result, pulley P2 can spin the coils faster. Finally, the coils are rotated inside the four permanent magnets' fields and generate an electric current to light up the LED lamp.

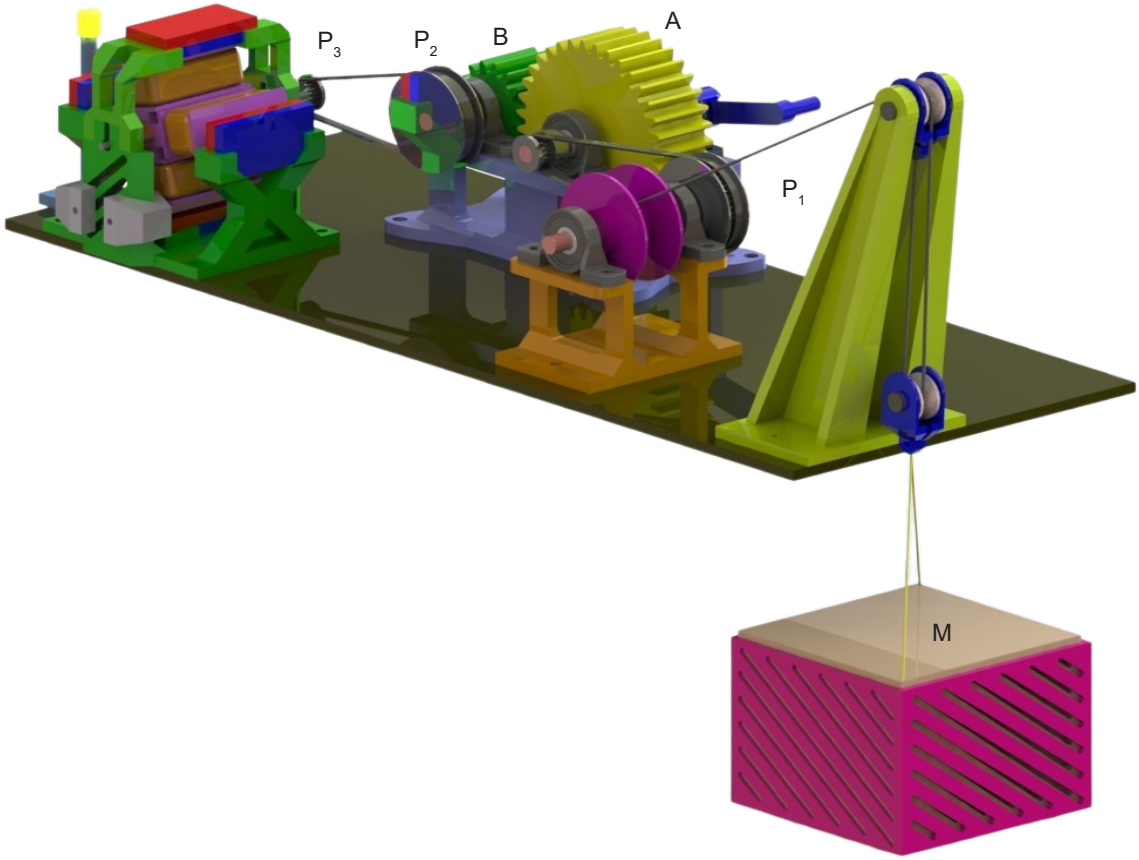


Figure 7. Combined System (3D Model for Complete System)

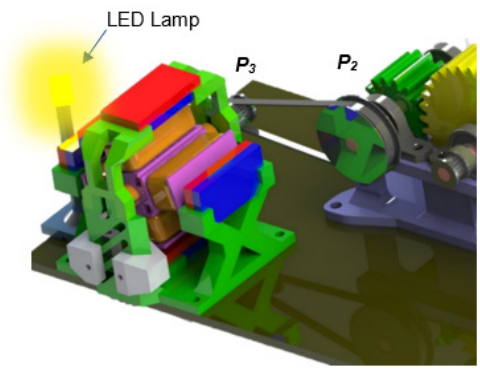


Figure 8. Electric Generator

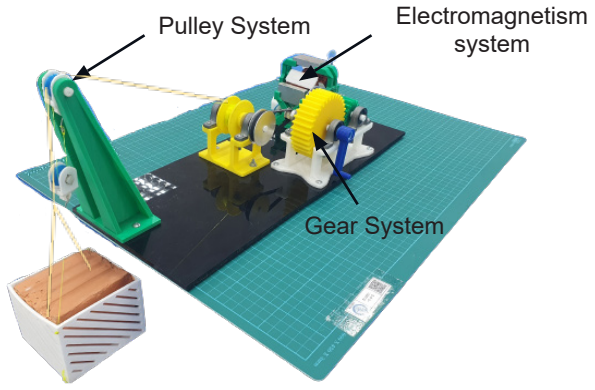


Figure 9. Assembly of 3D Printed Parts of the Prototype

4. 3D prototype

The prototype in Figure 10 is the combination of three main subsystems, including a pulley system, gear system, and Electromagnetism system (also shown in Figure 7). Most of the parts of each subsystem are produced by 3D printers, and other parts can be found in the local market, such as belts, LED lamps, coil wires, bearings, magnets, bolts, nuts, and so on. The 3D-printed files can be downloaded from the link here: https://drive.google.com/drive/folders/1GProVhLKhJQwZP2JJxg_qtAjGbauxsU9.

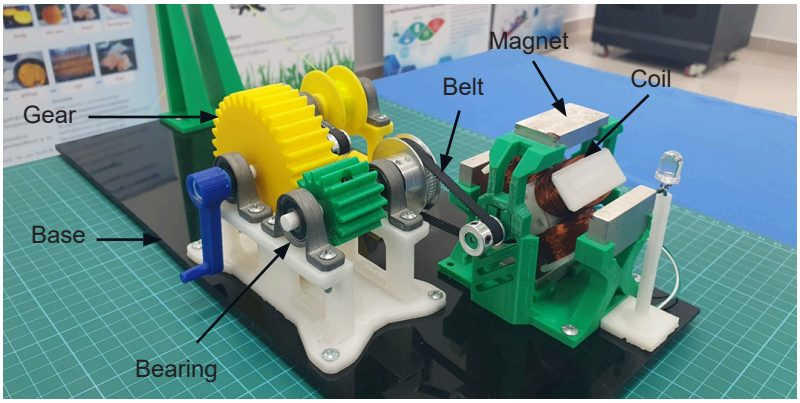


Figure 10. A complete Prototype

5. Conclusion

For the purpose of STEM education in lower secondary school curriculum, three main systems have been compiled into one set on the prototype of an educational tool in physics, and produced by using 3D printer. So that, lower secondary students could enhance their understanding of the subject matter in Physics' theory with the real practice. This also should encourage students' participation in physics class and curiosity about the interactions that can be made with objects in three dimensions (3D objects) in the educational system.

For future work, this educational tool prototype will be applied to the education system, especially, in lower secondary, in order to promote students' involvement and activity in the physics class and interest in how 3D things can interact with in the education system. Also, the learning instruction manual of this prototype will be written for better understanding or easy to the setup this prototype.

References

Ateş, Ö., and A. Eryilmaz. 2011. "Effectiveness of hands-on and minds-on activities on students' achievement and attitudes towards physics." Asia-Pacific Forum on Science Learning and Teaching 12 (1): 1-22.

Corum, K., & Garofalo, J. 2015. " Using digital fabrication to support student learning. ." In 3D Printing and additive Manufacturing, 50–55.

Curb, Foolish. 2015. Mechanical Engineering (BSME). Polytechnic University of the Philippines.
Jackson, Jane. 2016. "High school physics is crucial for STEM careers and STEM college majors, and for scientific and mathematical literacy." ASU Department of Physics http://modeling.asu.edu/modeling/HSphysics-STEMjobs,Literacy.pdf.

Kao, Sovansophal & Shimizu, Kinya. 2020. "A Review on STEM Enrollment in Higher Education of Cambodia: Current Status, Issues, and Implications of Initiatives." 26. 123-134.

Kashy, Edwin. 2018. Electromagnetism: Additional Information. Frank Neville H. Robinson: University Distinguished Professor Emeritus of Physics, Michigan State University, East Lansing.
MISTI. 2020. "Science, Technology & Innovation." 2-3. Phnom Penh: Ministry of Industry, Science, Technology & Innovation.

MoEYS. n.d. "Physics Book in Grade 9 of the Ministry of Education, Youth and Sports." By MoEYS, page 68. Phnom Penh.

Ornek, Funda. 2008. "What makes physics difficult?" International Journal of Environmental & Science Education ISSN 1306-3065.

Rokenbok. 2015. Stem Education- Simple Machine- Pulleys. STEM MAKER- Corriculum .

A Journey from Engineer to a CEO in a Tourism Tech-Startup

09

Mr. Pech Soveaddh
Master's Degree in Engineering in Industrial Engineering,
Mahidol University, Thailand

Who is He?

Mr. Pech Soveaddh is the CEO and Co-founder of Uot App. His role is to monitor overall to ensure growth and keep extending the partnership investment to maximize profit.
His educational background is in engineering and science. He graduated Bachelor's Degree in Engineering in Chemical Engineering and Food Technology from the Institute of Technology of Cambodia (ITC). Meanwhile, he also got a Bachelor's Degree of Science in Information Technology at the University of Cambodia. Without delay, after his undergraduate, he pursues his Master Degree abroad. He graduated Master's Degree in Engineering in Industrial Engineering from Mahidol University, the top-range university in Thailand.

He likes to explore and prototype new things. He likes reading articles about what is new in technology and the foresight trend of technology. Moreover, He likes reading books about leadership, and business, and learning about the successful entrepreneur's journey. Whenever he has good available time, he always manages to have adventure trips around Cambodia and abroad, which is a passionate factor for him to create Uot App.

1. Brief Education Life

Why do you think education is important, especially STI education?

Talking about education, I feel I am so lucky. I was born into a family that values education. So my parents design my life journey to get the very quality of education. That is why I value education too, especially STI education. It provides me the ability and skill of problem-solving for existing context and innovation toward the insight and foresight opportunity.

What motivated you to choose STI education?

When I was young, I liked the subject of mathematics, physic, chemistry, and more scientific subject. I was always in the top 3 outstanding students in class from primary school to high school. That is one of the reasons I like STI education. When I grew up, I did not know what STI was. I just knew that I would like to be Engineer. So I chose to study at ITC. From year 1 to year 5 in my university life, I found that I had chosen the right path for studying and understanding more about the importance of STI.

What is your oversea education experience?

Many things were gained during my oversea education! I got my Master's Degree with knowledge and wisdom to contribute to our society. A higher degree abroad is a passport to many more opportunities. It is a plus that I learned the culture and living in an international environment. Moreover, it is a good time for me to explore about my inner potential and I improve my strengths and decrease my weaknesses.

How does your education advance your career?

Holding a Master's Degree in Industrial Engineering gives me the opportunity to be prioritized by the originations that I worked for because I contribute that value-added to the organization.

Currently, being a CEO and co-founder, STI is very useful for me because I have the ability to analysis and critical thinking for decision-making for a better future for my business.

2. Experiences & Achievement

What inspired you to become who you are now?

Being an entrepreneur is my dream journey. I am inspired by many entrepreneurs who contribute to society with wisdom. So I start doing my action plan and collecting the skills and experiences from 10 years ago in my university life. One more important factor that influences me is my family, especially my mom, who is a seller, and my father is a teacher. So I combine my family personality and skills to become who I am today.

What are your greatest achievements/ accomplishments?

My big achievement is I co-founded a tech startup called Uot App, which is a digital community for trip lovers which aims to support Khmer tourism and enhance human well-being. We built Uot App from zero to be a real app that contributes real value to the users to have a happy trip with saving and feel so local Cambodian. As a result, we have very great teamwork. We got rewards such as the 2nd prize Startup Entrepreneur Award by Khmer Enterprise, and Green Industry Award by the Ministry of Industry, Science, Technology &

Innovation, and many more reward and grants.

How do you build the network or make a good collaboration with your partner?

I show honesty, and respect, and I value the relationship with my network and partners. The objective of the collaboration is to get win-win benefits for both parties.

How can you extend your skills into a professional setting?

I keep improving my skills and am curious about new technology trends and new knowledge about STI related and its application.

3. Personal Development

How did you start your personal development?

I use STI education, that I have the capital to improve IQ and EQ. I do not consider myself as a high IQ and EQ. However, I am able to use IQ for analyzing and critical thinking to problem-solving in business and careers. In addition, I use EQ to

solve work with people, meaning that if you got the self-awareness and are aware of the people around you, then it is more convenient to work together.

How to cope with the fear of failure?

“What does not kill you makes you stronger” is a key motor for me to face the fear of failure. I utilize my youth and energetic spirit to do what I am afraid to do. If it is successful, it is a great achievement, but if it fails, it is a lesson learned.

What is your life mission?

Being an entrepreneur with healthy, wealth, and contribution to society.

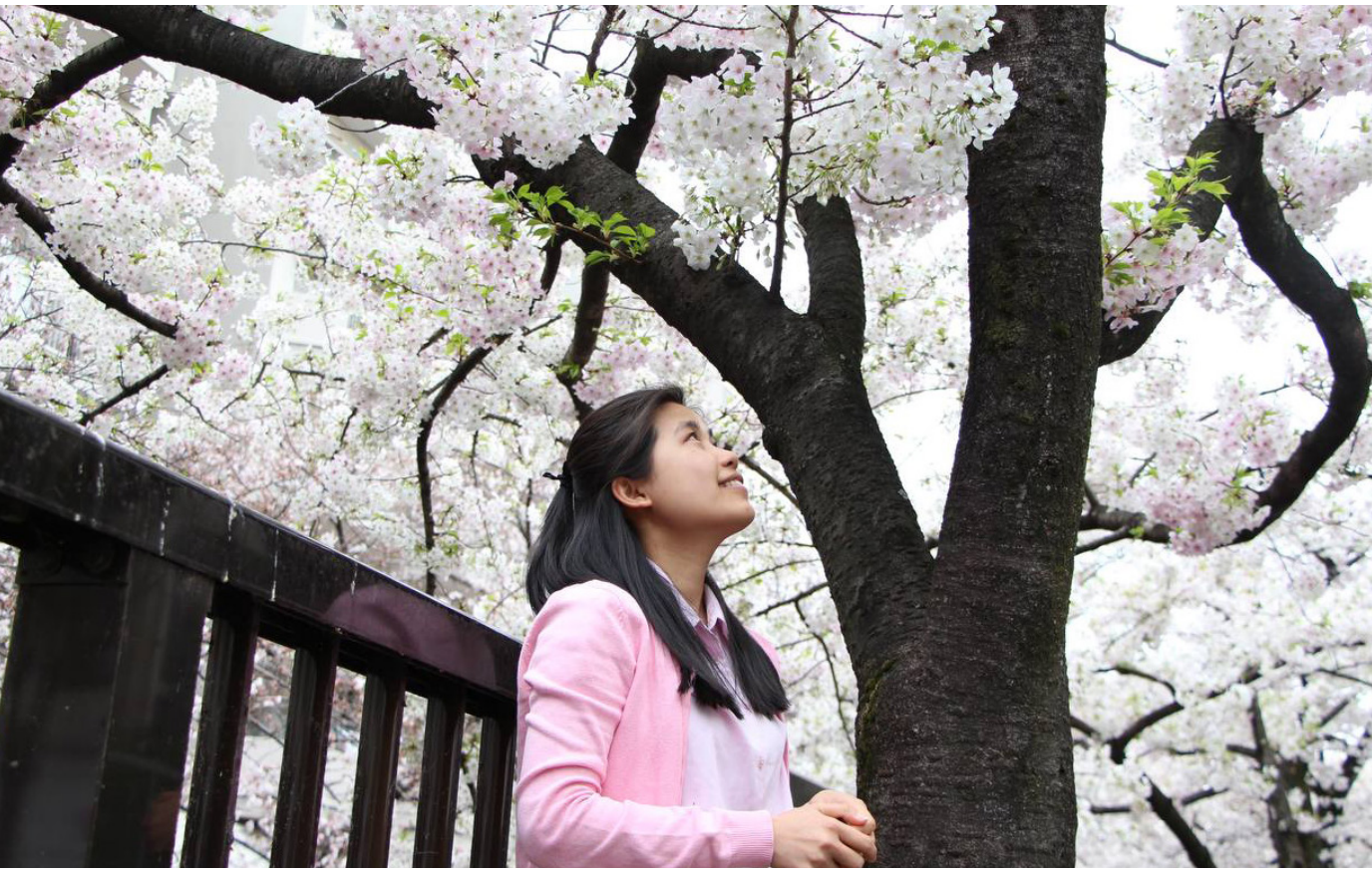
3. Advices to Next Generation

What is your message to the next generation in STI education and careers opportunity?

To my next generation, it is the right path to choose STI education. If you agree with me, what you need to do next is study hard with good results and focus on how to use STI education in the application and wisdom. Then you will excel in the right and successful career path.

Enjoy STI education and all the best!
Soveaddh...

DRIVER for Career Development: STI Education 10



Dr. Peng Chanthol
Ph.D. Degree in Life Science and Technology,
Tokyo Institute of Technology, Japan

Who is She?

Dr. PENG Chanthol is currently a Head of the Research Unit of Water and Environment, a lecturer and researcher at the Research and Innovation Center, and Faculty of Chemical and Food Engineering at the Institute of Technology of Cambodia. She graduated Doctor of Engineer in Life Science and Technology from the Tokyo Institute of Technology in Japan in 2019, a Master of Science in Sustainable Management of Food Quality in France in 2015, and an Engineering Degree in Chemical and Food Engineering in Cambodia at ITC in 2013. Her researches focus on Microbiology and Food Safety. Specifically, she leads several projects focusing on monitoring and characterizing antibiotic-resistant bacteria and foodborne pathogens in water and food products and developing interventions to prevent and reduce foodborne contamination along the food chain.

1. Education Life

Why do you think education is important, especially STI education?

Education is vital because it provides knowledge and critical thinking for correctly making any judgment and guides us to analyze what is right and wrong before making any decision. SIT education provides a technical skill that is the core competence of individuals so that they can choose the STI career path that is the best fit for them. As we are transforming into an era of Industrial 4.0, STI education is crucial for this digitalized era for socioeconomic improvement and development for Cambodia and beyond.

What motivates you to choose STI education?

I would say that teachers play a significant role in guiding students to choose a major and career pathway that best fits their core competence, and that way, they would advise the student to achieve their goals. When deciding on the major, I consulted with my high school teacher about the career path and university I should choose. He suggested that I should choose Engineering at ITC because it is one of the top universities

in Cambodia specializing in the Engineering field. As I was good in Mathematic and Physic, this major is the best fit for me. So, I decided to apply for a scholarship at ITC, choosing the Engineering field as a major. From that time, I studied very hard to prepare for the entrance exam, and finally, I passed to study there with a scholarship for five years, and I chose chemical and food engineering as my major.

What are your oversea education experiences?

I studied Master's Degree at three universities in overseas education includes both theories in classes and practices in laboratories. I remember that in one subject, at least, we studied with two to three professors who were academia and expert from the private sector. This is good because we can reflect on what we learn in class to be used in an actual application in private/industry sectors. Laboratory activities were divided into two: a confirmation experiment on what was learned in class and another part was conducting research/ experiment to answer the research questions for the thesis. It was the most challenging part, but at the same time, I learned a lot along the way. The most comfortable part of the laboratories was that they had a lot of equipment and facilities to ease the laboratory experiments and activities. We also had a weekly seminar in which all students in the laboratory shared the recently published research finding and their research progresses; so that everyone could provide some suggestions and learn from each other. The students in Japan work very hard in general, and they have high commitment, persevere, and are very hard-working.

2. Experiences & Achievement

What inspired you to become who you are now?

My father is the one. Since I was young, he has always encouraged me to study hard because education is essential and can be used to help ourselves, others, and society as a whole. I want to be an example for the next generation, especially for girls, that education has no gender barrier. Everyone should have the right and equity support for higher education.

What are your greatest achievements/ accomplishments?

I think passing the entrance exam and receiving a scholarship from ITC positively changed my life. Without a scholarship, I would not be able to pursue the university level as it would be costly for both tuition fees and living expenses in the city. If I could not study at the university, I probably would not be who I am today, and I could not imagine my life would be without advancing my education level.

How do you build the network or make a good collaboration with your partner?

Professional networking is essential for advancing our careers, and good collaboration can create a harmonized working environment, stressed-free, increase productivity, and achieve a common goal successfully. Still, it takes some time and skill to build it. Here are some tips that I can share based on my experiences to strengthen my networking

and collaboration skills:

- Know yourself, which means your strengths and weaknesses, so that you can figure out what professional partners you can work with well. It can be someone complementary to your weakness or vice versa.
- Set your discipline and choose the right people to be in a team, specifically those who share a mutual expectation of a team.
- Shared responsibility and integrity are essential for long-term collaboration.
- Make time to meet with new people via training, meeting, and conferences
- Update information on professional online platforms frequently, such as LinkedIn or ResearchGate.

3. Personal Development

How did you start your personal development?

We have to assess our strengths and weaknesses so that we can know what strengths we have to build and improve. This includes both soft and hard skills. It is a lifelong process of learning and development. These are essential for us to maximize our potential and build confidence. I started personal development when I started my university at ITC. I had to arrange the schedule for self-study and group work. It was hard, but I learned about time management and how to do things effectively. I often attended workshops and training on managing time, like a daily schedule, checklist, goal setting within a timeframe, leadership, and communication skills. This skill is also beneficial for me now because I can manage tasks and time efficiently. Nowadays, I still improve my skill by listening to recorded audio by experts on personal development as a routine habit.

What is your life mission?

Somehow it is difficult to define the life mission or purpose of life. However, once we define it, it is halfway to success. My life mission is to use my knowledge to benefit the young generation and humanity/society as a whole. I want to use my specialized skills to improve food safety and public health in Cambodia.

4. Advices to Next Generation

What is your message to the next generation in STI education and careers opportunity?

It is essential to define your life's purpose, what you want to do or study, and why. Because it will help you to do it the right way and achieve it. STEM education is about 30% at the tertiary level, based on the report, which is very low. As our country is preparing for industry 4.0, STEM and STI education is crucial to this era of economic development. So why not pursue SIT education?

5.Acknowledgment

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